ERRATA

Page 1 - Nomenclature

Radius should be R

Length should be L

Page 9

P.I. Station 20+00 should be 21+00

Page 116

Table XXXIV should be XXXI

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
F. A. SILCOX, Forester

ENGINEERING FIELD TABLES

✦

SECOND EDITION
1935

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CONTENTS

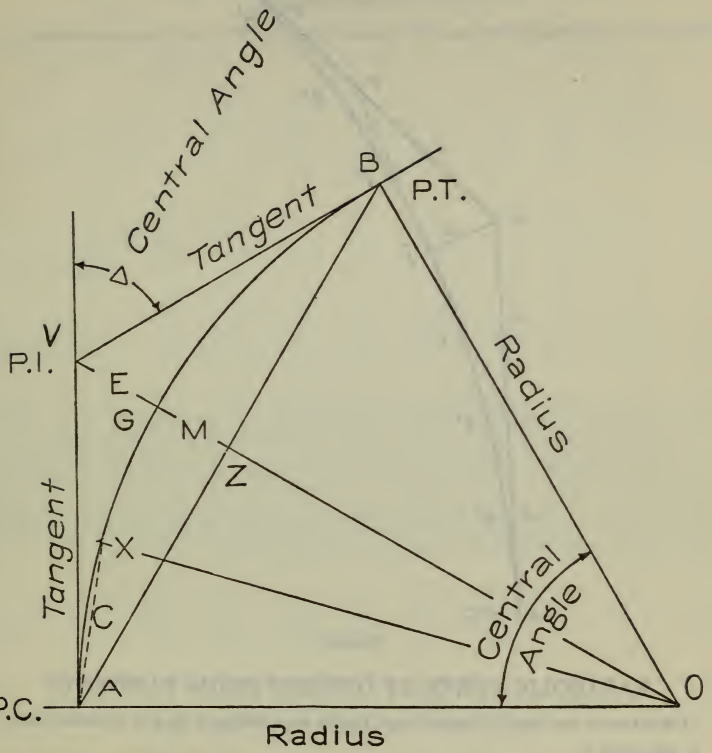


FIGURE 1

Nomenclature

L = Radius = $OA = OB = OG$
R = Length of curve = AGB
L_c = Long chord = AZB
T = Tangent distance = $AV = BV$
E = External distance = GV
M = Middle ordinate = GZ
Δ = Central angle = PI angle
VAB = Tot. def. angle = $\frac{1}{2} AOB = \frac{1}{2}\Delta$
C = Any short chord as AX
$VAX = \frac{1}{2}AOX$ = Deflection angle for C

Formulae

$T = R \tan \frac{1}{2}\Delta$
$L_c = 2R \sin \frac{1}{2}\Delta$
$M = R(1-\cos\frac{1}{2}\Delta)$
$E = \frac{R}{\cos \frac{1}{2}\Delta} - R$
$\text{Sin } \frac{1}{2} AOB = \frac{AB}{2R}$
$\text{Sin def. angle } VAX = \frac{C}{2R}$
$\text{Def. for 1 foot} = \frac{\text{def. angle for chord}}{\text{chord length}}$

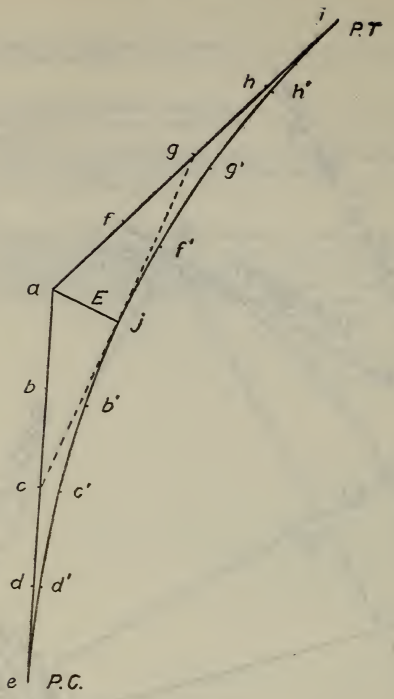


FIGURE 2

PARABOLIC CURVE BY OFFSETS FROM TANGENTS

(For curves of less than 45° central angle results are sufficiently close to a circular curve)

1. Establish *PI*.
2. Set stakes at *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, and *i* in order named. The distances between these stakes to be equal.
3. Sight between *c* and *g* to establish *j* which should be approximately equidistant between *c* and *g*. Point *j* is now the midpoint of the curve.
4. Measure the external $aj = E$.
5. Offset stakes *d*, *c*, *b*, *f*, *g*, and *h* to *d'*, *c'*, *b'*, *f'*, *g'*, and *h'*, respectively. The amount of offset will be as follows:

dd' and $hh' = \frac{1}{16} E$
cc' and $gg' = \frac{1}{4} E$
bb' and $ff' = \frac{9}{16} E$

When the tangent distance, PC to PI is less than 200 feet points d, b, f, and h may be omitted if desired, leaving only c and g midway between PC—PI and PI—PT, respectively. Points c and g should then be offset a distance of ¼ E to c' and g', respectively.

If it is desired to place stakes at other than the above points along the tangent the proper offset can be computed by the following formula:

$$\text{Offset} = \left(\frac{\text{Distance from } PC \text{ to point}}{\text{Distance from } PC \text{ to } PI}\right)^2 \times E$$

For points between PI and PT the above formula will apply by substituting PT for PC.

METHOD OF LAYING OUT A CURVE BY TANGENT OFFSETS

Formula for tangent offset = Radius − $\sqrt{\text{Radius}^2 - \text{tangent distance}^2}$ = $OT - \sqrt{OT^2 - TD^2}$

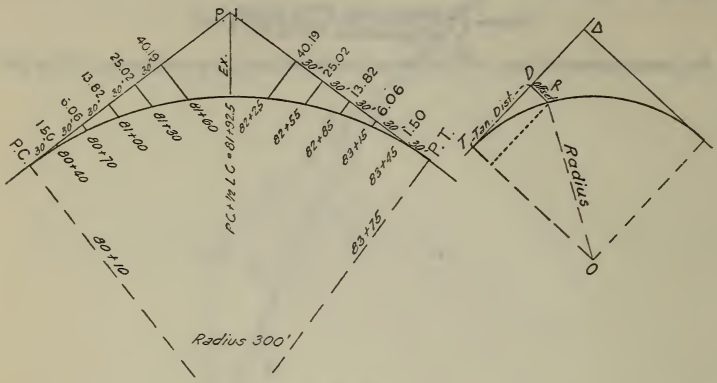


FIGURE 3.

To lay out a curve by use of tangent offset tables:

Set stakes on tangents at distances from the *PC* and *PT* equal to tenths of the curve radius.

Offset these stakes at right angles to the tangent by the amount indicated in table I.

Example.—See figure 3.

Curve radius=300 feet. Set stakes at 30-foot intervals along the tangent from *PC* and *PT*. Station 80+40 is 30 feet or 0.1 radius from *PC*; 80+70 is 60 feet or 0.2 radius; 81+00 is 0.3 radius from *PC*, etc.

In table I opposite radius 300 find the offset for 80+40 under tangent distance of 0.1 radius. This is 1.50 feet. The offset of 6.06 for station 80+70 is found under tangent distance of 0.2 radius, and 13.82 feet offset under 0.3 radius for station 81+00.

Table I.—TANGENT OFFSETS FOR CURVES, RADII 40 TO 4,000 FEET

From *PC* or *PT* toward *PI* in tenths of radius distance

Radius	Tangent distance in decimals of radius								
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
40	0.20	0.81	1.84	3.34	5.36	8.00	11.43	16.00	22.56
50	.25	1.01	2.30	4.17	6.70	10.00	14.29	20.00	28.21
60	.30	1.21	2.76	5.00	8.04	12.00	17.15	24.00	33.85
70	.35	1.41	3.22	5.84	9.38	14.00	20.01	28.00	39.49
80	.40	1.62	3.68	6.67	10.72	16.00	22.87	32.00	45.13
90	.45	1.82	4.15	7.51	12.06	18.00	25.73	36.00	50.77
100	.50	2.02	4.61	8.34	13.40	20.00	28.59	40.00	56.41
110	.55	2.22	5.07	9.17	14.74	22.00	31.44	44.00	62.05
120	.60	2.43	5.53	10.01	16.08	24.00	34.30	48.00	67.69
130	.65	2.63	5.99	10.84	17.42	26.00	37.16	52.00	73.33
140	.70	2.83	6.45	11.67	18.76	28.00	40.02	56.00	78.98
150	.75	3.03	6.91	12.51	20.10	30.00	42.88	60.00	84.62
160	.80	3.23	7.37	13.34	21.44	32.00	45.74	64.00	90.26
170	.85	3.44	7.83	14.18	22.77	34.00	48.60	68.00	95.90
180	.90	3.64	8.29	15.01	24.11	36.00	51.50	72.00	101.50
190	.95	3.84	8.75	15.84	25.45	38.00	54.30	76.00	107.20
200	1.00	4.04	9.21	16.68	26.79	40.00	57.20	80.00	112.80
210	1.05	4.24	9.67	17.51	28.13	42.00	60.00	84.00	118.50
220	1.10	4.45	10.13	18.35	29.47	44.00	62.90	88.00	124.10
230	1.15	4.65	10.59	19.18	30.81	46.00	65.70	92.00	129.70
240	1.20	4.85	11.05	20.01	32.15	48.00	68.60	96.00	135.40
250	1.25	5.05	11.52	20.85	33.49	50.00	71.50	100.00	141.00
275	1.37	5.56	12.67	22.93	36.84	55.00	78.60	110.00	155.10
300	1.50	6.06	13.82	25.02	40.19	60.00	85.80	120.00	169.20
325	1.63	6.57	14.97	27.10	43.54	65.00	92.90	130.00	183.30
350	1.75	7.07	16.12	29.19	46.89	70.00	140.00	140.00	197.40
375	1.87	7.575	17.27	31.28	50.24	75.00	107.20	150.00	211.50
400	2.00	8.08	18.42	33.36	53.59	80.00	114.30	160.00	225.60
425	2.13	8.585	19.72	35.45	56.94	85.00			
450	2.25	9.09	20.73	37.53	60.29	90.00			
475	2.37	9.60	21.88	39.61	63.64	95.00			
500	2.50	10.11	23.03	41.70	66.99	100.00			
550	2.75	11.12	25.33	45.86	73.68	110.00			
600	3.00	12.13	27.64	50.03	80.38	120.00			
650	3.25	13.14	29.94	54.20	87.08	130.00			
700	3.50	14.15	32.24	58.37	93.78	140.00			
750	3.75	15.16	34.54	62.54	100.49	150.00			
800	4.00	16.17	36.85	66.71	107.20	160.00			
850	4.25	17.18	39.15	70.88	113.90	170.00			
900	4.50	18.19	41.45	75.05	120.60	180.00			
950	4.75	19.20	43.76	79.22	127.30	190.00			
1,000	5.00	20.21	46.06	83.39	134.00	200.00			
Factor	0.005	0.0202	0.0461	0.0834	0.1340	0.2000	0.2860	0.4000	0.5641

Table I.—TANGENT OFFSETS FOR CURVES, RADII 40 TO 4,000 FEET—Continued

From *PC* or *PT* toward *PI* in tenths of radius distance

Radius	Tangent distance in decimals of radius								
	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45
1,000	1.25	5.00	11.46	20.21	31.80	46.06	63.25	83.485	
1,100	1.38	5.50	12.61	22.23	34.98	50.47	69.58	91.83	
1,200	1.50	6.00	13.75	24.25	38.16	54.87	75.90	100.18	
1,300	1.63	6.50	14.90	26.27	41.34	59.28	82.23	108.52	
1,400	1.75	7.00	16.04	28.29	44.52	63.68	88.55	116.87	
1,500	1.88	7.50	17.90	30.31	47.70	68.09	94.88	125.22	
1,600	2.00	8.00	18.34	32.33	50.88	72.50	101.20	133.57	
1,700	2.13	8.50	19.48	34.35	54.06	76.90	107.53	141.91	
1,800	2.25	9.00	20.63	36.37	57.24	81.31	113.85	150.26	
1,900	2.38	9.50	21.77	38.39	60.42	85.71	120.18	158.61	
2,000	2.50	10.00	22.92	40.42	63.60	92.12	126.50	166.96	
2,100	2.63	10.50	24.07	42.44	66.78	96.73			
2,200	2.75	11.00	25.21	44.46	69.96	101.33			
2,300	2.88	11.50	26.36	46.48	73.14	105.94			
2,400	3.00	12.00	27.50	48.50	76.32	110.54			
2,500	3.13	12.50	28.65	50.53	79.50	115.15			
2,600	3.25	13.00	29.80	52.55	82.68	119.76			
2,700	3.38	13.50	30.94	54.57	85.86	124.36			
2,800	3.50	14.00	32.09	56.59	89.04	128.97			
2,900	3.63	14.50	33.23	58.61	92.22	133.57			
3,000	3.75	15.00	34.38	60.63	95.40	138.18			
3,100	3.88	15.50	35.53	62.65	98.58				
3,200	4.00	16.00	36.67	64.67	101.76				
3,300	4.13	16.50	37.82	66.69	104.94				
3,400	4.25	17.00	38.96	68.71	108.12				
3,500	4.38	17.50	40.11	70.74	111.30				
3,600	4.50	18.00	41.26	72.76	114.48				
3,700	4.63	18.50	42.40	74.78	117.66				
3,800	4.75	19.00	43.55	76.80	120.84				
3,900	4.88	19.50	44.69	78.82	124.02				
4,000	5.00	20.00	45.84	80.84	127.20				
Factor	0.00125	0.00500	0.01146	0.02021	0.03180	0.04606	0.06325	0.08349	0.10697

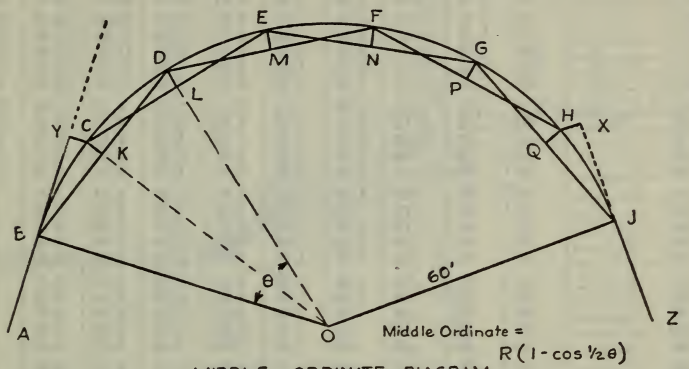
To find the tangent offset for curves of any radius not given in the above table, take the "factor" for the proper tangent distance and multiply this factor by the radius.

EXAMPLE.—Required tangent offset for 1,215-foot radius curve at a tangent distance of 0.35 of the radius. From table opposite "factor" under column headed "0.35" find 0.06325, multiply by 1,215. Tangent offset $=0.06325\times1{,}215=76.84$ feet.

METHOD OF LAYING OUT A CURVE BY MIDDLE ORDINATES

Extend the tangent beyond the *PC* of the curve one-half of the selected chord length. Find the middle ordinate from the table for the proper radius and the full chord length. Lay off *YC* perpendicular to the tangent equal to the middle ordinate. *C* is a point on the curve. Lay off *CK* equal to the middle ordinate and *BK* equal to one-half of the chord. Extend *BK* to *D* with *KD* equal to one-half the chord. *D* is a point on the curve. Lay off *DL* equal to *CK* and project *CL* to *E*. Locate succeeding points on the curve in the same manner to the *PT*.

From *H* the middle ordinate distance should also be set off on the outside of the curve to locate point *X* at one-half the chord length from *J* which is necessary to establish the direction of the tangent through the *PT*.



MIDDLE ORDINATE DIAGRAM

FIGURE 4.

Table II.—MIDDLE ORDINATES

[In feet]

Radius (feet)	Chord length in feet									
	20	25	30	40	50	60	70	80	90	100
40	1.27	2.00	2.95	5.38	8.78	13.58	27.10	------	------	------
45	1.10	1.77	2.57	4.69	7.58	11.45	16.71	24.39	------	------
50	1.01	1.59	2.30	4.18	6.70	10.00	14.28	20.00	28.20	------
55	.92	1.44	2.10	3.77	6.01	8.90	12.57	17.24	23.36	------
60	.84	1.31	1.91	3.43	5.45	8.04	11.27	15.27	20.31	26.83
65	.78	1.21	1.75	3.15	5.00	7.33	10.23	13.62	18.10	23.46
70	.72	1.13	1.63	2.92	4.62	6.75	9.38	12.56	16.39	21.03
75	.68	1.05	1.51	2.71	4.29	6.26	8.66	11.56	15.00	19.09
80	.63	.98	1.42	2.54	4.01	5.83	7.76	10.72	13.48	17.55
85	.60	.93	1.33	2.39	3.76	5.47	7.54	10.00	12.89	16.27
90	.56	.87	1.26	2.22	3.54	5.14	7.08	9.37	12.06	15.17
100	.50	.78	1.12	2.00	3.26	4.54	6.18	8.08	10.26	12.72
110	.46	.71	1.03	1.83	2.88	4.18	5.72	7.51	9.63	12.02
120	.42	.65	.94	1.68	2.63	3.81	5.21	6.86	8.76	10.91
130	.39	.60	.87	1.55	2.43	3.51	4.79	6.31	8.79	10.00
140	.36	.56	.81	1.44	2.25	3.25	4.45	5.84	7.43	9.22
150	.33	.52	.75	1.34	2.10	3.03	4.14	5.43	6.90	8.57
160	.31	.49	.71	1.26	1.96	2.87	3.87	5.08	6.46	8.02
170	.29	.46	.66	1.18	1.85	2.67	3.64	4.76	6.06	7.52
180	.28	.44	.63	1.12	1.74	2.52	3.44	4.50	5.72	7.09
190	.26	.41	.59	1.06	1.65	2.38	3.25	4.26	5.41	6.69
200	.25	.39	.56	1.00	1.63	2.27	3.09	4.04	5.13	6.36
210	.24	.37	.54	.96	1.49	2.16	2.94	3.85	4.87	6.03
220	.23	.60	.51	.92	1.43	2.06	2.81	3.68	4.66	5.76
230	.22	.34	.49	.87	1.37	1.96	2.68	3.51	4.45	5.50
240	.21	.33	.47	.84	1.31	1.89	2.57	3.36	4.27	5.23
250	.20	.31	.45	.80	1.25	1.81	2.46	3.21	4.08	5.05
275	.18	.28	.41	.73	1.14	1.64	2.24	2.93	3.71	4.58
300	.17	.25	.38	.68	1.05	1.51	2.07	2.70	3.42	4.13
325	.16	.21	.35	.62	.97	1.39	1.89	2.47	3.12	3.87
350	.13	.22	.32	.58	.90	1.29	1.74	2.30	2.90	3.60
375	.13	.21	.30	.53	.83	1.20	1.63	2.14	2.71	3.35
400	.12	.19	.28	.50	.78	1.13	1.54	2.02	2.55	3.15
425	.12	.18	.26	.47	.72	1.06	1.44	1.89	2.39	2.95
450	.11	.17	.25	.45	.69	1.00	1.37	1.78	2.25	2.79
475	.10	.17	.24	.42	.66	.95	1.30	1.69	2.13	2.64
500	.10	.16	.22	.41	.62	.89	1.23	1.60	2.03	2.49
550	.09	.14	.20	.36	.57	.82	1.12	1.45	1.84	2.28
600	.08	.13	.19	.33	.52	.75	1.03	1.34	1.75	2.21
650	.08	.12	.17	.31	.48	.70	.94	1.24	1.56	1.93
700	.07	.12	.16	.29	.45	.64	.87	1.13	1.45	1.80
750	.07	.10	.15	.27	.42	.61	.81	1.06	1.34	1.66
800	.06	.09	.14	.25	.38	.56	.76	1.00	1.26	1.57
850	.06	.09	.13	.23	.37	.51	.72	.95	1.19	1.48
900	.05	.09	.13	.22	.35	.49	.68	.89	1.12	1.39
950	.05	.09	.12	.21	.33	.47	.64	.85	1.07	1.32
1,000	.05	.08	.11	.20	.31	.45	.61	.81	1.02	1.25
1,100	.04	.07	.11	.18	.28	.41	.55	.74	.93	1.15
1,200	.04	.06	.10	.17	.26	.37	.50	.67	.84	1.04
1,300	.04	.06	.08	.16	.24	.35	.47	.62	.78	.94
1,400	.04	.06	.08	.14	.22	.32	.43	.57	.73	.90
1,500	.04	.05	.08	.14	.21	.30	.40	.53	.67	.83
1,600	.03	.05	.06	.13	.19	.27	.38	.50	.64	.77
1,700	.03	.05	.06	.12	.19	.25	.36	.48	.60	.74
1,800	.03	.05	.07	.11	.18	.24	.34	.44	.56	.70

METHOD OF LAYING OUT A CURVE WITH AN ENGINEER'S TRANSIT

Refer to fig. 5.

Required to lay out a curve between tangents having a *PI* angle of 37°10′, also that the external distance be approximately 30 ft. From table III tangents and externals for curves of radius=1 on page 12 under "Central angle" 37°10′ find 0.05501 for a radius=1. By approximation note that 500×0.055=27.5 and that 550×0.05501=30.26. Therefore a 550-foot radius curve will give an external distance of 30.26 feet and will be adopted.

A 550-foot radius curve with central angle of 37°10′ will be computed.

External distance (from above) will be 30.26′.

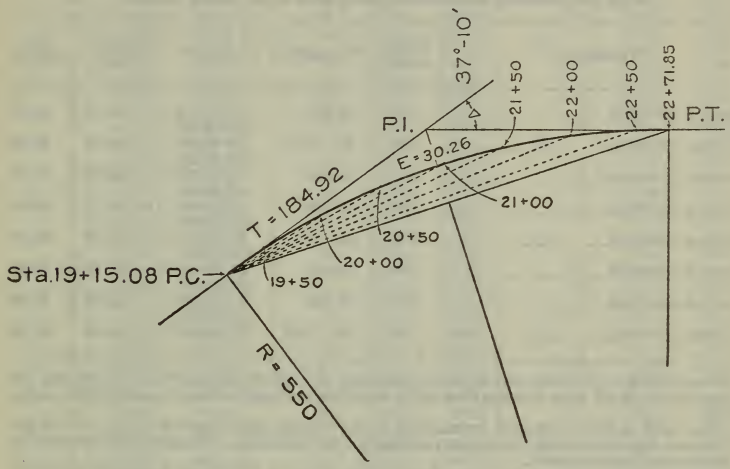


FIGURE 5.

Tangent distance (from same table) will be 0.33621×550′=184.92 feet. First, in staking out curve transit should be set up at *PI* and this distance measured back (from *PI*) on each tangent, establishing the *PC* and *PT* of the curve.

From lengths of circular arcs R=1
Under 37° find 0.64577
Under 10′ find .00291

Length of curve = .64868×550=356.77 feet.

Establish stationing of curve as follows:

PI station	20+0.00
Tangent distance	−1+84.92
PC station	19+15.08
Curve length	+3+56.77
PT station	22+71.85

From table deflection angles for curves of various radii and chord lengths under radius of 550′ find—

Arc length	Chord length	Deflection	Deflection per foot
50′	49.98	2°36.26′	3.125′

To "get on" an even 50′ station the first chord will have to be 19+50−19+15.08 station of *PC*=34.92′. Since this subchord is more than half of the chord length, it will be more correct to subtract the deflection for 15.08 feet from the deflection for 1 chord—i. e., 15.08×3.125=47.125′

2 36.26′	deflection 1—chord, length	49.98 arc length	50.00
−47.125′	deflection difference length	−15.08 arc length	−15.08
1° 49.135′	deflection for subchord length	34.90 ft. arc length	34.92 ft.

Transit at—	Back-sight	Foresight	Deflection	Chord length	Arc length
Station 19=15.08	*PI*	19+50	1° 49.135′	34.90	34.92
			+2° 36.25′		
Station 19=15.08	*PI*	20+00	4° 25.395′	49.98	50.00
			+2° 36.26′		
Station 19=15.08	*PI*	20+50	7° 01.655′	49.98	50.00
			+2° 36.26′		
Station 19=15.08	*PI*	21+00	9° 37.915′	49.98	50.00
			+2° 36.26′		
Station 19=15.08	*PI*	21+50	12° 14.175′	49.98	50.00
			+2° 36.26′		
Station 19=15.08	*PI*	22+00	14° 50.435′	49.98	50.00
			+2° 36.26′		
Station 19=15.08	*PI*	22+50	17° 26.695′	49.98	50.00
			+1° 08.28′		
Station 19=15.08	*PI*	22+71.85	18° 34.975′	21.85	21.85

From 22+50 to 22+71.85 will require a deflection of 3.125×21.85=68.28′ or 1° 08.28′ and the chord will be 21.85, since it is less than half a chord the arc length will be considered the same, 21.85.

The total deflection should be one-half of the central angle one-half of 37° 10′=18° 35′. This is an important check on any curve deflection computation. The error of 0.025′ equal to 1½ seconds is unimportant.

Assume that it is impossible to see from *PC* to station 21+50: Move transit up to station 21+00. Set vernier plates on 0° backsight on *PC*, plunge telescope and turn transit until vernier reading is 12° 15′. Set station 21+50 on line, 49.98′ from station 21+00. Stations 22, 22+50, and *PT* 22+71.85 can be set from station 21+00 by turning to their corresponding deflection and measuring the indicated chord distance from the previous point.

NOTE.—The above example is carried out to extreme accuracy for purposes of illustration. However, for Forest Service curves it will not be necessary to read angles closer than the nearest 5 minutes or to measure distances closer than the nearest tenth of a foot. Tacks will not be necessary in stakes.

Table III.—TANGENTS AND EXTERNALS FOR CURVES OF RADIUS=1

Central angle	Tangent distance	External distance	Central angle	Tangent distance	External distance	Central angle	Tangent distance	External distance
° ′			° ′			° ′		
1	0. 00873	0. 00004	11	0. 09629	0. 00463	21	0. 18534	0. 01703
10	.01018	.00005	10	.09776	.00477	10	.18684	.01731
20	.01164	.00007	20	.09923	.00491	20	.18835	.01758
30	.01309	.00009	30	.10069	.00506	30	.18986	.01786
40	.01455	.00011	40	.10216	.00521	40	.19136	.01815
50	.01600	.00013	50	.10363	.00536	50	.19287	.01843
2	.01746	.00015	12	.10510	.00551	22	.19438	.01872
10	.01891	.00018	10	.10657	.00566	10	.19589	.01901
20	.02036	.00021	20	.10805	.00582	20	.19740	.01930
30	.02182	.00024	30	.10952	.00598	30	.19891	.01959
40	.02328	.00027	40	.11099	.00614	40	.20042	.01989
50	.02473	.00031	50	.11246	.00630	50	.20194	.02019
3	.02619	.00034	13	.11394	.00647	23	.20345	.02049
10	.02764	.00038	10	.11541	.00664	10	.20497	.02079
20	.02910	.00042	20	.11688	.00681	20	.20648	.02110
30	.03055	.00047	30	.11836	.00698	30	.20800	.02140
40	.03201	.00051	40	.11983	.00715	40	.20952	.02171
50	.03346	.00056	50	.12131	.00733	50	.21104	.02203
4	.03492	.00061	14	.12278	.00751	24	.21256	.02234
10	.03638	.00066	10	.12426	.00769	10	.21408	.02266
20	.03783	.00072	20	.12574	.00787	20	.21560	.02298
30	.03929	.00077	30	.12722	.00806	30	.21712	.02330
40	.04075	.00083	40	.12869	.00825	40	.21864	.02362
50	.04220	.00089	50	.13017	.00844	50	.22017	.02395
5	.04366	.00095	15	.13165	.00863	25	.22169	.02428
10	.04512	.00102	10	.13313	.00882	10	.22322	.02461
20	.04658	.00108	20	.13461	.00902	20	.22475	.02494
30	.04803	.00115	30	.13609	.00922	30	.22628	.02528
40	.04949	.00122	40	.13758	.00942	40	.22781	.02562
50	.05095	.00130	50	.13906	.00962	50	.22934	.02596
6	.05241	.00137	16	.14054	.00983	26	.23087	.02630
10	.05387	.00145	10	.14202	.01004	10	.23240	.02665
20	.05533	.00153	20	.14351	.01024	20	.23393	.02700
30	.05678	.00161	30	.14499	.01046	30	.23547	.02735
40	.05824	.00169	40	.14648	.01067	40	.23700	.02770
50	.05970	.00178	50	.14796	.01089	50	.23854	.02806
7	.06116	.00187	17	.14945	.01111	27	.24008	.02842
10	.06262	.00196	10	.15094	.01133	10	.24162	.02878
20	.06408	.00205	20	.15243	.01155	20	.24316	.02914
30	.06554	.00215	30	.15391	.01178	30	.24470	.02950
40	.06700	.00224	40	.15540	.01200	40	.24624	.02987
50	.06847	.00234	50	.15689	.01223	50	.24788	.03024
8	.06993	.00244	18	.15838	.01247	28	.24933	.03061
10	.07139	.00254	10	.15988	.01270	10	.25087	.03099
20	.07285	.00265	20	.16137	.01294	20	.25242	.03137
30	.07431	.00276	30	.16286	.01318	30	.25397	.03175
40	.07578	.00287	40	.16435	.01342	40	.25552	.03213
50	.07724	.00298	50	.16585	.01366	50	.25707	.03251
9	.07870	.00309	19	.16734	.01391	29	.25862	.03290
10	.08017	.00321	10	.16884	.01415	10	.26017	.03329
20	.08163	.00333	20	.17033	.01440	20	.26172	.03368
30	.08309	.00345	30	.17183	.01466	30	.26328	.03408
40	.08456	.00357	40	.17333	.01491	40	.26483	.03447
50	.08602	.00369	50	.17483	.01517	50	.26639	.03487
10	.08749	.00382	20	.17633	.01543	30	.26795	.03528
10	.08895	.00395	10	.17783	.01569	10	.26951	.03568
20	.09042	.00408	20	.17933	.01595	20	.27107	.03609
30	.09189	.00421	30	.18083	.01622	30	.27263	.03650
40	.09335	.00435	40	.18233	.01649	40	.27419	.03691
50	.09482	.00449	50	.18384	.01676	50	.27576	.03732

Table III.—TANGENTS AND EXTERNALS FOR CURVES OF RADIUS = 1—Continued

Central angle	Tangent distance	External distance	Central angle	Tangent distance	External distance	Central angle	Tangent distance	External distance
° ′			° ′			° ′		
31	0.27732	0.03774	41	0.37388	0.06761	51	0.47698	0.10793
10	.27889	.03816	10	.37554	.06819	10	.47876	.10870
20	.28046	.03858	20	.37720	.06878	20	.48055	.10947
30	.28203	.03901	30	.37887	.06936	30	.48234	.11025
40	.28360	.03944	40	.38053	.06995	40	.48414	.11103
50	.28517	.03987	50	.38220	.07055	50	.48593	.11181
32	.28675	.04030	42	.38386	.07115	52	.48773	.11260
10	.28832	.04073	10	.38553	.07174	10	.48953	.11339
20	.28990	.04117	20	.38721	.07235	20	.49134	.11419
30	.29147	.04161	30	.38888	.07295	30	.49315	.11499
40	.29305	.04206	40	.39055	.07356	40	.49495	.11579
50	.29463	.04250	50	.39223	.07417	50	.49677	.11659
33	.29621	.04295	43	.39391	.07479	53	.49858	.11740
10	.29780	.04340	10	.39559	.07540	10	.50040	.11821
20	.29938	.04385	20	.39727	.07602	20	.50222	.11903
30	.30097	.04431	30	.39896	.07665	30	.50404	.11985
40	.30255	.04477	40	.40065	.07727	40	.50587	.12067
50	.30414	.04523	50	.40234	.07790	50	.50769	.12150
34	.30573	.04569	44	.40403	.07853	54	.50953	.12233
10	.30732	.04616	10	.40572	.07917	10	.51136	.12316
20	.30891	.04663	20	.40741	.07981	20	.51319	.12400
30	.31051	.04710	30	.40911	.08045	30	.51503	.12484
40	.31210	.04757	40	.41081	.08109	40	.51688	.12568
50	.31370	.04805	50	.41251	.08174	50	.51872	.12653
35	.31530	.04853	45	.41421	.08239	55	.52057	.12738
10	.31690	.04901	10	.41592	.08305	10	.52242	.12824
20	.31850	.04950	20	.41763	.08370	20	.52427	.12910
30	.32010	.04998	30	.41933	.08436	30	.52613	.12996
40	.32171	.05047	40	.42105	.08503	40	.52798	.13083
50	.32331	.05097	50	.42276	.08569	50	.52985	.13170
36	.32492	.05146	46	.42447	.08636	56	.53171	.13257
10	.32653	.05196	10	.42619	.08703	10	.53358	.13345
20	.32814	.05246	20	.42791	.08771	20	.53545	.13433
30	.32975	.05297	30	.42963	.08839	30	.53732	.13521
40	.33136	.05347	40	.43136	.08907	40	.53920	.13610
50	.33298	.05398	50	.43308	.08975	50	.54107	.13700
37	.33460	.05449	47	.43481	.09044	57	.54296	.13789
10	.33621	.05501	10	.43654	.09113	10	.54484	.13879
20	.33783	.05552	20	.43828	.09183	20	.54673	.13970
30	.33945	.05604	30	.44001	.09252	30	.54862	.14061
40	.34108	.05657	40	.44175	.09323	40	.55051	.14152
50	.34270	.05709	50	.44349	.09393	50	.55241	.14243
38	.34433	.05762	48	.44523	.09464	58	.55431	.14335
10	.34596	.05815	10	.44697	.09535	10	.55621	.14428
20	.34758	.05869	20	.44872	.09606	20	.55812	.14521
30	.34922	.05922	30	.45047	.09678	30	.56003	.14614
40	.35085	.05976	40	.45222	.09750	40	.56194	.14707
50	.35248	.06030	50	.45397	.09822	50	.56385	.14801
39	.35412	.06085	49	.45573	.09895	59	.56577	.14896
10	.35576	.06140	10	.45748	.09968	10	.56769	.14990
20	.35740	.06195	20	.45924	.10041	20	.56962	.15085
30	.35904	.06250	30	.46101	.10115	30	.57155	.15181
40	.36068	.06306	40	.46277	.10189	40	.57348	.15277
50	.36232	.06362	50	.46454	.10263	50	.57541	.15373
40	.36397	.06418	50	.46631	.10338	60	.57735	.15470
10	.36562	.06474	10	.46808	.10413	10	.57929	.15567
20	.36727	.06531	20	.46985	.10488	20	.58124	.15665
30	.36892	.06588	30	.47163	.10564	30	.58318	.15763
40	.37057	.06645	40	.47341	.10640	40	.58513	.15861
50	.37223	.06703	50	.47519	.10716	50	.58709	.15960

Table III.—TANGENTS AND EXTERNALS FOR CURVES OF RADIUS=1—Continued

Central angle	Tangent distance	External distance	Central angle	Tangent distance	External distance	Central angle	Tangent distance	External distance
° ′			° ′			° ′		
61	0.58905	0.16059	71	0.71329	0.22833	81	0.85408	0.31509
10	.59101	.16159	10	.71549	.22960	10	.85660	.31672
20	.59297	.16259	20	.71769	.23089	20	.85912	.31837
30	.59494	.16359	30	.71990	.23217	30	.86166	.32002
40	.59691	.16460	40	.72211	.23347	40	.86419	.32168
50	.59888	.16562	50	.72432	.23476	50	.86674	.32334
62	.60086	.16663	72	.72654	.23607	82	.86929	.32501
10	.60284	.16766	10	.72877	.23738	10	.87184	.32669
20	.60483	.16868	20	.73100	.23869	20	.87441	.32838
20	.60681	.16971	30	.73323	.24001	30	.87698	.33007
40	.60881	.17075	40	.73547	.24134	40	.87955	.33177
50	.61080	.17178	50	.73771	.24267	50	.88204	.33348
63	.61280	.17283	73	.73996	.24400	83	.88473	.33519
10	.61480	.17388	10	.74221	.24534	10	.88732	.33691
20	.61681	.17493	20	.74447	.24669	20	.88992	.33864
30	.61882	.17598	30	.74674	.24804	30	.89253	.34038
40	.62083	.17704	40	.74900	.24940	40	.89515	.34212
50	.62285	.17811	50	.75128	.25077	50	.89777	.34387
64	.62487	.17918	74	.75355	.25214	84	.90040	.34563
10	.62689	.18025	10	.75584	.25351	10	.90304	.34740
20	.62892	.18133	20	.75812	.25489	20	.90569	.34917
30	.63095	.18241	30	.76042	.25628	30	.90834	.35095
40	.63299	.18350	40	.76272	.25767	40	.91099	.35274
50	.63503	.18459	50	.76502	.25907	50	.91366	.35454
65	.63707	.18569	75	.76733	.26047	85	.91633	.35634
10	.63912	.18679	10	.76964	.26188	10	.91901	.35815
20	.64117	.18790	20	.77196	.26330	20	.92170	.35997
30	.64322	.18901	30	.77428	.26472	30	.92439	.36180
40	.64528	.19012	40	.77661	.26615	40	.92709	.36363
50	.64734	.19124	50	.77895	.26758	50	.92980	.36548
66	.64941	.19236	76	.78129	.26902	86	.93252	.36733
10	.65148	.19349	10	.78363	.27046	10	.93524	.36919
20	.65355	.19463	20	.78598	.27191	20	.93797	.37105
30	.65563	.19576	30	.78834	.27337	30	.94071	.37293
40	.65771	.19691	40	.79070	.27483	40	.94345	.37481
50	.65980	.19805	50	.79306	.27630	50	.94620	.37670
67	.66189	.19920	77	.79544	.27778	87	.94896	.37860
10	.66398	.20036	10	.79781	.27926	10	.95173	.38051
20	.66608	.20152	20	.80020	.28075	20	.95451	.38242
30	.66818	.20269	30	.80258	.28224	30	.95729	.38434
40	.67028	.20386	40	.80498	.28374	40	.96008	.38628
50	.67239	.20504	50	.80738	.28525	50	.96288	.38822
68	.67451	.20622	78	.80978	.28676	88	.96569	.39016
10	.67663	.20740	10	.81220	.28828	10	.96850	.39212
20	.67875	.20859	20	.81461	.28980	20	.97133	.39409
30	.68088	.20979	30	.81703	.29133	30	.97416	.39606
40	.68301	.21099	40	.81946	.29287	40	.97700	.39804
50	.68514	.21220	50	.82190	.29442	50	.97984	.40003
69	.68728	.21341	79	.82434	.29579	89	.98270	.40203
10	.68942	.21462	10	.82678	.29752	10	.98556	.40404
20	.69157	.21584	20	.82923	.29909	20	.98843	.40606
30	.69372	.21707	30	.83169	.30066	30	.99131	.40808
40	.69588	.21830	40	.83415	.30223	40	.99420	.41012
50	.69804	.21953	50	.83662	.30382	50	.99710	.41216
70	.70021	.22077	80	.83910	.30541	90	1.00000	.41421
10	.70238	.22202	10	.84158	.30700	10	1.00291	.41627
20	.70455	.22327	20	.84407	.30861	20	1.00583	.41835
30	.70673	.22453	30	.84656	.31022	30	1.00876	.42042
40	.70891	.22579	40	.84906	.31183	40	1.01170	.42251
50	.71110	.22706	50	.85157	.31346	50	1.01465	.42461

Table III.—TANGENTS AND EXTERNALS FOR CURVES OF RADIUS = 1—Continued

Central angle	Tangent distance	External distance	Central angle	Tangent distance	External distance	Central angle	Tangent distance	External distance
° ′			° ′			°		
91	1.01761	0.42672	109	1.40195	0.72205	127	2.00569	1.24116
20	1.02355	.43096	20	1.41061	.72911			
40	1.02952	.43524	40	1.41934	.73624	128	2.05030	1.28117
92	1.03553	.43956	110	1.42815	.74345	129	2.09654	1.32282
20	1.04158	.44391	20	1.43703	.75073			
40	1.04766	.44831	40	1.44598	.75808	130	2.14451	1.36620
93	1.05378	.45274	111	1.45501	.76552	131	2.19430	1.41142
20	1.05994	.45721	20	1.46411	.77303			
40	1.06613	.46173	40	1.47330	.78062	132	2.24604	1.45859
94	1.07237	.46628	112	1.48256	.78829	133	2.29984	1.50784
20	1.07864	.47087	20	1.49190	.79604			
40	1.08496	.47551	40	1.50133	.80388	134	2.35585	1.55930
95	1.09131	.48019	113	1.51084	.81180	135	2.41421	1.61313
20	1.09770	.48491	20	1.52043	.81981			
40	1.10414	.48967	40	1.43010	.82790	136	2.47509	1.66947
96	1.11061	.49448	114	1.53986	.83608	137	2.53865	1.72850
20	1.11713	.49933	20	1.54972	.84435			
40	1.12369	.50422	40	1.55966	.85271	138	2.60509	1.79043
97	1.13029	.50916	115	1.56696	.86116	139	2.67462	1.85545
20	1.13694	.51415	20	1.57981	.86970			
40	1.14363	.51918	40	1.59002	.87834	140	2.74748	1.92380
98	1.15037	.52425	116	1.60033	.88708	141	2.82391	1.99574
20	1.15715	.52938	20	1.61074	.89591			
40	1.16398	.53455	40	1.62125	.90485	142	2.90421	2.07155
99	1.17085	.53977	117	1.63185	.91388	143	2.98868	2.15155
20	1.17777	.54504	20	1.64256	.92302			
40	1.18474	.55036	40	1.65337	.93226	144	3.07768	2.23607
100	1.19175	.55572	118	1.66428	.94160	145	3.17159	2.32551
20	1.19882	.56114	20	1.67530	.95106			
40	1.20593	.56661	40	1.68643	.96062	146	3.27085	2.42030
101	1.21310	.57213	119	1.69766	.97029	147	3.37594	2.52094
20	1.22031	.57771	20	1.70901	.98008			
40	1.22758	.58333	40	1.72047	.98998	148	3.48741	2.62796
102	1.23490	.58902	120	1.73205	1.00000	149	3.60588	2.74198
20	1.24227	.59475	20	1.74375	1.01014			
40	1.24969	.60054	40	1.75556	1.02039	150	3.73205	2.86370
103	1.25717	.60639	121	1.76749	1.03077	151	3.86671	2.99393
20	1.26471	.61229	20	1.77955	1.04128			
40	1.27230	.61825	40	1.79174	1.05191	152	4.01078	3.13357
104	1.27994	.62427	122	1.80405	1.06267	153	4.16530	3.28366
20	1.28764	.63035	20	1.81649	1.07356			
40	1.29541	.63648	40	1.82906	1.08458	154	4.33148	3.44541
105	1.30323	.64268	123	1.84177	1.09574	155	4.51071	3.62023
20	1.31110	.64894	20	1.85462	1.10704			
40	1.31904	.65526	40	1.86760	1.11847	156	4.70463	3.80973
106	1.32704	.66164	124	1.88073	1.13005	157	4.91516	4.01585
20	1.33511	.66809	20	1.89400	1.14178			
40	1.34323	.67460	40	1.90741	1.15366	158	5.14455	4.24084
107	1.35142	.68117	125	1.92098	1.16568	159	5.39552	4.48740
20	1.35968	.68782	20	1.93470	1.17786			
40	1.36800	.69452	40	1.94858	1.19019	160	5.67128	4.75877
108	1.37638	.70130	126	1.96261	1.20269	161	5.97576	5.05886
20	1.38484	.70815	20	1.97681	1.21535			
40	1.39336	.71506	40	1.99116	1.22817	162	6.31375	5.39245

Table IV.—LENGTHS OF CIRCULAR ARCS RADIUS=1

Degrees	Length	Degrees	Length	Minutes	Length
1	0.01745	61	1.06465	1	0.00020
2	.03490	62	1.08210	2	.00058
3	.05235	63	1.09955	3	.00087
4	.06981	64	1.11701	4	.00116
5	.08726	65	1.13446	5	.00145
6	.10471	66	1.15191	6	.00174
7	.12217	67	1.16937	7	.00203
8	.13962	68	1.18682	8	.00232
9	.15707	69	1.20427	9	.00261
10	.17453	70	1.22173	10	.00290
11	.19198	71	1.23918	11	.00319
12	.20943	72	1.25663	12	.00349
13	.22689	73	1.27409	13	.00378
14	.24434	74	1.29154	14	.00407
15	.26179	75	1.30899	15	.00436
16	.27925	76	1.32645	16	.00465
17	.29670	77	1.34390	17	.00494
18	.31415	78	1.36135	18	.00523
19	.33161	79	1.37881	19	.00552
20	.34906	80	1.39626	20	.00581
21	.36651	81	1.41371	21	.00610
22	.38397	82	1.43117	22	.00639
23	.40142	83	1.44862	23	.00669
24	.41887	84	1.46607	24	.00698
25	.43633	85	1.48352	25	.00727
26	.45378	86	1.50098	26	.00756
27	.47123	87	1.51843	27	.00785
28	.48869	88	1.53588	28	.00814
29	.50614	89	1.55334	29	.00843
30	.52359	90	1.57079	30	.00872
31	.54105	91	1.58824	31	.00901
32	.55850	92	1.60570	32	.00930
33	.57595	93	1.62315	33	.00959
34	.59341	94	1.64060	34	.00989
35	.61086	95	1.65806	35	.01018
36	.62831	96	1.67551	36	.01047
37	.64577	97	1.69296	37	.01076
38	.66322	98	1.71042	38	.01105
39	.68067	99	1.72787	39	.01134
40	.69813	100	1.74532	40	.01163
41	.71558	101	1.76278	41	.01192
42	.73303	102	1.78023	42	.01221
43	.75049	103	1.79768	43	.01250
44	.76794	104	1.81514	44	.01279
45	.78539	105	1.83259	45	.01309
46	.80285	106	1.85004	46	.01338
47	.82030	107	1.86750	47	.01367
48	.83775	108	1.88495	48	.01396
49	.85521	109	1.90240	49	.01425
50	.87266	110	1.91986	50	.01454
51	.89011	111	1.93731	51	.01483
52	.90757	112	1.95476	52	.01512
53	.92502	113	1.97222	53	.01541
54	.94247	114	1.98967	54	.01570
55	.95993	115	2.00712	55	.01599
56	.97738	116	2.02458	56	.01628
57	.99483	117	2.04203	57	.01658
58	1.01229	118	2.05948	58	.01687
59	1.02974	119	2.07694	59	.01716
60	1.04719	120	2.09439	60	.01745

Table V.—DEFLECTION ANGLES FOR CURVES OF VARIOUS RADII AND CHORD LENGTHS

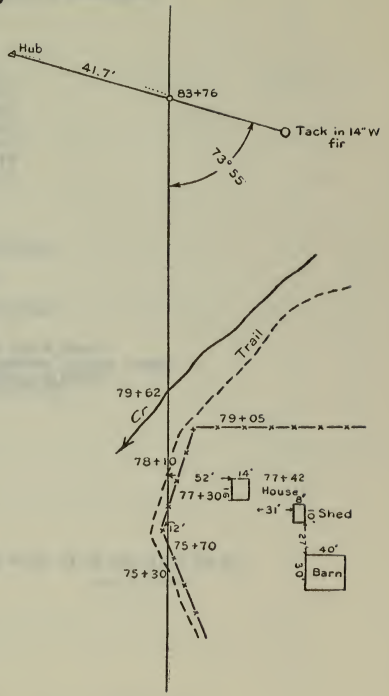
Radius	Curve length	Chord length	Deflection angle	Deflection for 1 foot	Radius	Curve length	Chord length	Deflection angle	Deflection for 1 foot
	Feet	*Feet*	° ′	*Minutes*		*Feet*	*Feet*	° ′	*Minutes*
40	15	14.82	10 40.58	42.9717	450	50	49.97	3 10.99	3.820
45	15	14.93	9 32.96	38.1971	475	50	49.98	3 01.44	3.629
50	15	14.94	8 35.66	34.3774	500	50	49.98	2 51.89	3.438
55	15	14.96	7 48.78	31.2522	550	50	49.98	2 36.26	3.125
60	15	14.97	7 09.71	28.6478	600	50	49.99	2 23.24	2.865
65	20	19.89	8 47.88	26.4441	650	50	50.00	2 12.22	2.644
70	20	19.93	8 11.11	24.5553	700	100	99.92	4 05.56	2.456
75	20	19.93	7 38.37	22.9182	750	100	99.93	3 49.19	2.292
80	20	19.94	6 53.27	21.4858	800	100	99.93	3 34.86	2.149
85	20	19.95	6 44.43	20.2220	850	100	99.94	3 22.22	2.022
90	20	19.96	6 21.97	19.0980	900	100	99.95	3 10.99	1.910
95	20	19.97	6 01.87	18.0033	950	100	99.95	3 00.93	1.809
100	25	24.93	7 09.72	17.189	1000	100	99.96	2 51.89	1.719
110	25	24.95	6 30.65	15.626	1100	100	99.96	2 36.26	1.563
120	25	24.96	5 58.10	14.324	1200	100	99.97	2 23.24	1.432
130	25	24.96	5 30.55	13.222	1300	100	99.97	2 12.22	1.322
140	25	24.96	5 06.94	12.278	1400	100	99.98	2 02.78	1.228
150	25	24.97	4 46.98	11.459	1500	100	99.98	1 54.59	1.146
160	25	24.97	4 28.58	10.743	1600	100	99.98	1 47.43	1.074
170	25	24.97	4 12.77	10.111	1700	100	99.99	1 41.11	1.011
180	25	24.98	3 58.73	9.549	1800	100	99.99	1 35.49	.955
190	25	24.98	3 46.17	9.047	1900	100	100.00	1 30.47	.905
200	25	24.98	3 34.85	8.594	2000	100	100.00	1 25.95	.859
210	25	24.98	3 26.26	8.250	2100	100	100.00	1 22.51	.825
220	25	24.98	3 17.67	7.907	2200	100	100.00	1 19.07	.791
230	25	24.99	3 09.07	7.563	2300	100	100.00	1 15.63	.756
240	25	24.99	3 00.48	7.220	2400	100	100.00	1 12.19	.722
250	25	24.99	2 51.89	6.876	2500	100	100.00	1 08.75	.688
275	25	24.99	2 36.26	6.250	3000	100	100.00	57.29	.573
300	50	49.94	4 46.48	5.730	3500	100	100.00	50.13	.502
325	50	49.95	4 24.44	5.289	4000	100	100.00	42.97	.430
350	50	49.96	4 05.56	4.911	4500	100	100.00	38.68	.387
375	50	49.96	3 49.18	4.584	5000	100	100.00	34.38	.344
400	50	49.97	3 34.86	4.297	6000	100	100.00	28.65	.286
425	50	49.97	3 28.98	4.059	7000	100	100.00	24.55	.246

Table VI.—MINUTES IN DECIMALS OF A DEGREE

1	0.0167	11	0.1833	21	0.3500	31	0.5167	41	0.6833	51	0.8500
2	.0333	12	.2000	22	.3667	32	.5333	42	.7000	52	.8667
3	.0500	13	.2167	23	.3833	33	.5500	43	.7167	53	.8833
4	.0667	14	.2333	24	.4000	34	.5667	44	.7333	54	.9000
5	.0833	15	.2500	25	.4167	35	.5833	45	.7500	55	.9167
6	.1000	16	.2667	26	.4333	36	.6000	46	.7667	56	.9333
7	.1167	17	.2833	27	.4500	37	.6167	47	.7833	57	.9500
8	.1333	18	.3000	28	.4667	38	.6333	48	.8000	58	.9667
9	.1500	19	.3167	29	.4833	39	.6500	49	.8167	59	.9833
10	.1667	20	.3333	30	.5000	40	.6667	50	.8333	60	1.0000

TRANSIT NOTES

Sta.	L.	R.	Compass bearing	Corrected bearing	Curve sta.
			N. 40° 15′ W.	N. 40° 30′ W.	
					P. T. 84+13.4
+76	21° 30′				Ex. 83+75.7
	R. 200′				
	T. 38.0′				P. C. 83+38.0
	L. 75.4′				
	Ex. 3.6′				
248.9′			N. 19° 10′ W.	N. 19° 00′ W.	
					P. T. 81+90.8
81+33.5		34° 30′			Ex. 81+30.3
		R. 200′			
		T. 63.7			P. C. 80+69.8
		L. 121.0			
		Ex. 9.4			
183.5′			N. 53° 30′ W.	N. 53° 30′ W.	
					P. T. 79+97.0
79+51	26° 30′				Ex. 79+50.5
	R. 200′				
	T. 47.0				P. C. 79+04.0
	L. 93.0				
	Ex. 5.5				
390.4′			N. 27° 30′ W.	N. 27° 00′ W.	
					P. T. 76+48.8
75+63	20° 0′				Ex. 75+61.8
	R. 500				
	T. 88.2				P. C. 74+74.8
	L. 174.0				
	Ex. 7.7				
			N. 6° 45′ W.	N. 7° 00′ W.	



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LEVEL NOTES

Sta.	(Back sight) +	H. I.	(Fore sight) −	Rod	Elev.	
B. M.					4165.07	Nail in base of 26″ fir 70′ left of sta. 0+50.
	1.49	4166.56				
T. P.			1.90		4164.66	
	6.88	4171.54				
0+00				0.5	4171.0	
+75				2.0	4169.5	
1+00				4.0	4167.5	
+20				10.2	4161.3	
+37				11.8	4159.7	
+53				11.0	4160.5	W. L. south side of creek.
2+00				7.2	4164.3	Bottom of channel, Willow Creek.
+50				8.3	4163.2	W. L. north side of creek.
T. P.			6.88		4164.66	
	0.75	4165.41				
4+00				3.2	4162.2	
+50				3.8	4161.6	
5+00				5.1	4160.3	
+27				4.2	4161.2	
+36				6.2	4159.2	
+52				8.1	4157.3	−15.98
+76				7.0	4158.4	+9.12
+89				6.2	4159.2	−6.86
6+00				5.1	4160.3	4165.07
T. P.			7.20		4158.21	4158.21
	9.12		15.98			

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COMPASS AND ABNEY SURVEY FIELD NOTES

Sta.	Dist. in feet	Grade	Mag. bearing	Side slope %		Remarks
					R	
28+00						
	100	−7%	S. 50° W..	−25	+15	
27+00						
	100	−7%	S. 30° W..	−30	+30	
26+00						
	50	−7%	S. 40° W..	−25	+25	
25+50						End of loose rock.
	100	−7%	S. 50° W..	−30	+30	
24+50						Loose rock.
	100	−7%	S. 30° W..	−40	+40	
23+50						End of solid rock.
	55	−7%	S. 40° W..	−55	+55	
+95						Solid rock.
	45	−7%	S. 30° W..	−60	+60	
22+50						In solid rock.
	100	−7%	S. 20° W..	−45	+50	Solid rock at 21+55.
+50						
	50	−7%	S. 30° W..	−40	+40	
21+00						
	85	−7%	S. 40° W..	−20	+20	
20+15						
	65	−7%	S. 40° W..	−25	+25	
+50						
	50	−7%	S. 45° W..	−30	+30	
19+00						

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ABNEY CROSS-SECTION NOTES, PERCENT

Sta.	L	℄	R	CLASSIFICATION AND DRAINAGE: Exc.	Clear. & Grub.	Drainage.	Remarks.
196	+60/100 +27/11	+35/7 −32/30		⩔ ⩓			
+15	+66/100	+35/8 −37/30					
+33	+50/30 +62/11	+34/7 −20/25 −33/30		70% S. R. 30% L. R.			
+60	+37/30	+33/20 −21/9 −1/12 −42/21 −52/30				+22—12″ pipe	Spring-Need Ditch 50′ each way
+84	+55/30	+19/5 −48/16 −36/30					Turnout
197+18	20′ ⧹|21′	+26/15 −45/10 −31/30		20% S. R. ⩔ 60% L. R. ⩓ 20% C.			
+84	+10/20 2′ ⧹|27′	+4/7 −10/12 −31/30		⩔ ⩓	Brush and Alders—Avg. about 2—		
198	+2/13 4′ ⧹|23′	+10/7 −35/25			10″ Firs per. sta. —Few windfalls. Est. Cl.-$ per A. Gr.-$ ″ ″		
199	+53/30 +52/20	+58/11 +8/5 −40/25 W. L.		50% S. R. 50% L. R.			
+60	+32/15 3′ ⧹|16′	+25/11 −25/10 −43/12 −41/21 W. L.					
200	+64/42 +11/4	3′ ⧹|16′ 0/4 −28/15 −37/26 W. L.					Camp site across creek
+50	+88/20 +125/11	+36/8 −31/25		100% S. R. ⩔	Dense reproduction 25 yrs. old Small amount of down timber. Est. Cl.-$ per A. Gr.-$ ″ ″	+12—18″ pipe	

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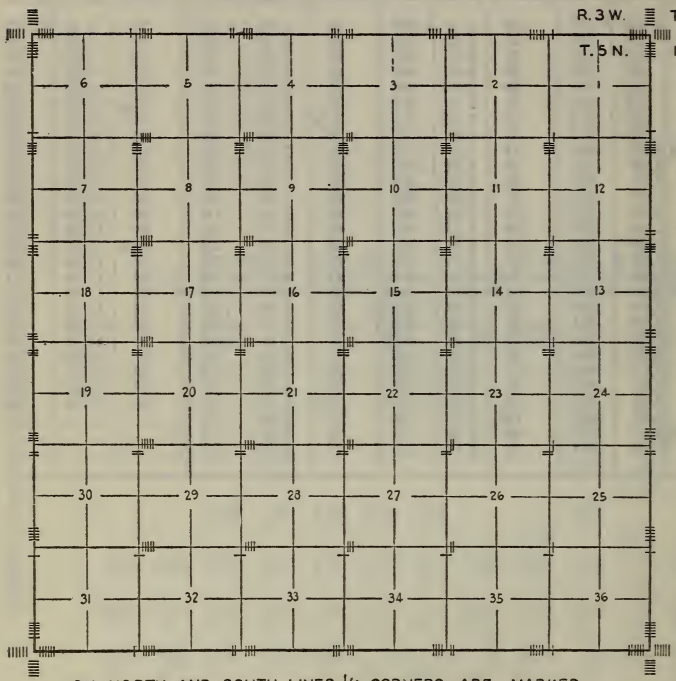
Table VII.—ACRES REQUIRED FOR DIFFERENT WIDTHS

[Per mile, and per 100 feet]

Width, feet	Acres per mile	Acres per 100 feet	Width, feet	Acres per mile	Acres per 100 feet	Width, feet	Acres per mile	Acres per 100 feet	Width, feet	Acres per mile	Acres per 100 feet
1	0.121	0.002	26	3.15	0.060	52	6.30	0.119	78	9.45	0.179
2	.242	.005	27	3.27	.062	53	6.42	.122	79	9.58	.181
3	.364	.007	28	3.39	.064	54	6.55	.124	80	9.70	.184
4	.485	.009	29	3.52	.067	55	6.67	.126	81	9.82	.186
5	.606	.011	30	3.64	.069	56	6.79	.129	82	9.94	.188
6	.727	.014	31	3.76	.071	57	6.91	.131	82½	10.00	.189
7	.848	.016	32	3.88	.073	57¾	7.00	.133	83	10.10	.190
8	.970	.018	33	4.00	.076	58	7.03	.133	84	10.20	.193
8¼	1.00	.019	34	4.12	.078	59	7.15	.135	85	10.30	.195
9	1.09	.021	35	4.24	.080	60	7.27	.138	86	10.40	.197
10	1.21	.023	36	4.36	.083	61	7.39	.140	87	10.50	.200
11	1.33	.025	37	4.48	.085	62	7.52	.142	88	10.70	.202
12	1.46	.028	38	4.61	.087	63	7.64	.145	89	10.80	.204
13	1.58	.030	39	4.73	.090	64	7.76	.147	90	10.90	.207
14	1.70	.032	40	4.85	.092	65	7.88	.149	90¾	11.00	.209
15	1.82	.034	41	4.97	.094	66	8.00	.151	91	11.00	.209
16	1.94	.037	41¼	5.00	.094	67	8.12	.154	92	11.20	.211
16½	2.00	.038	42	5.09	.096	68	8.24	.156	93	11.30	.213
17	2.06	.039	43	5.21	.099	69	8.36	.158	94	11.40	.216
18	2.18	.041	44	5.33	.101	70	8.48	.161	95	11.50	.218
19	2.30	.044	45	5.45	.103	71	8.61	.163	96	11.60	.220
20	2.42	.046	46	5.58	.106	72	8.73	.165	97	11.80	.223
21	2.55	.048	47	5.70	.108	73	8.85	.168	98	11.90	.225
22	2.67	.051	48	5.82	.110	74	8.97	.170	99	12.00	.227
23	2.79	.053	49	5.94	.112	74¼	9.00	.170	100	12.10	.230
24	2.91	.055	49½	6.00	.114	75	9.09	.172	-------	-------	------
24¾	3.00	.057	50	6.06	.115	76	9.21	.174	-------	-------	------
25	3.03	.057	51	6.18	.117	77	9.33	.177	-------	-------	------

SYSTEM OF MARKING CORNERS AS EMPLOYED
BY THE GENERAL LAND OFFICE.

TOWNSHIP NO. 5 N. RANGE NO. 3 W. MERIDIAN.



ON NORTH AND SOUTH LINES 1/4 CORNERS ARE MARKED (1/4 S) ON WEST FACE.

ON EAST AND WEST LINES 1/4 CORNERS ARE MARKED (1/4 S) ON NORTH FACE.

FIG. 6

Range and Township line corners bear grooves on the faces of the stone. Section corners are marked with notches on the edges of the stone.

Table VIII.—CONVERSION OF SLOPE DISTANCES TO HORIZONTAL DISTANCES

[Percent Abney and 100-foot tape]

Slope distance, feet	Per cent																		
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
2	2.0	2.0	2.0	1.9	1.9	1.9	1.9	1.8	1.8	1.8	1.7	1.7	1.6	1.6	1.6	1.5	1.5	1.5	1.4
4	4.0	4.0	3.9	3.9	3.8	3.8	3.7	3.6	3.6	3.5	3.4	3.4	3.3	3.2	3.1	3.0	3.0	2.9	2.8
6	6.0	5.9	5.9	5.8	5.7	5.7	5.6	5.5	5.4	5.3	5.1	5.0	4.9	4.8	4.7	4.6	4.5	4.4	4.2
8	8.0	7.9	7.8	7.8	7.7	7.6	7.4	7.3	7.2	7.0	6.9	6.7	6.6	6.4	6.2	6.1	5.9	5.8	5.7
10	10.0	9.9	9.8	9.7	9.6	9.4	9.3	9.1	8.9	8.8	8.6	8.4	8.2	8.0	7.8	7.6	7.4	7.3	7.1
12	11.9	11.9	11.8	11.6	11.5	11.3	11.1	10.9	10.7	10.5	10.3	10.1	9.8	9.6	9.4	9.1	8.9	8.7	8.5
14	13.9	13.8	13.7	13.6	13.4	13.2	13.0	12.8	12.5	12.3	12.0	11.7	11.2	11.2	10.9	10.7	10.4	10.2	9.9
16	15.9	15.8	15.7	15.5	15.3	15.1	14.9	14.6	14.3	14.0	13.7	13.4	13.1	12.8	12.5	12.2	11.9	11.6	11.3
18	17.9	17.8	17.7	17.5	17.2	17.0	16.7	16.4	16.1	15.8	15.4	15.1	14.7	14.4	14.1	13.7	13.4	13.1	12.7
20	19.9	19.8	19.6	19.4	19.2	18.9	18.6	18.2	17.9	17.5	17.1	16.8	16.4	16.0	15.6	15.2	14.9	14.5	14.1
22	21.9	21.8	21.6	21.3	21.1	20.8	20.4	20.1	19.7	19.3	18.9	18.4	18.0	17.6	17.2	16.8	16.4	15.9	15.6
24	23.9	23.7	23.5	23.3	23.0	22.7	22.3	21.9	21.5	21.0	20.6	20.1	19.7	19.2	18.7	18.3	17.8	17.4	17.0
26	25.9	25.7	25.5	25.2	24.9	24.5	24.1	23.7	23.3	22.8	22.3	21.8	21.3	20.8	21.3	19.8	19.3	19.8	18.4
28	27.9	27.7	27.5	27.2	26.8	26.4	26.0	25.5	25.0	24.5	24.0	23.5	22.4	22.9	21.9	21.3	20.8	20.3	19.8
30	29.9	29.7	29.4	29.1	28.7	28.3	27.9	27.4	26.8	26.3	25.7	25.2	24.6	24.0	23.4	22.9	22.3	21.7	21.2
32	31.8	31.6	31.4	31.0	30.7	30.2	29.7	29.2	28.6	28.0	27.4	26.8	26.2	25.6	25.0	24.4	23.8	23.2	22.6
34	33.8	33.6	33.3	33.0	32.6	32.1	31.6	31.0	30.4	29.8	29.2	28.5	27.9	27.2	26.5	25.9	25.3	24.6	24.0
36	35.8	35.6	35.3	34.9	34.5	34.0	33.4	32.8	32.2	31.5	30.9	30.2	29.5	28.8	28.1	27.4	26.8	26.1	25.5
38	37.8	37.6	37.3	37.0	36.4	35.9	35.3	34.7	34.0	33.3	32.6	31.9	31.1	30.4	29.7	29.0	28.2	27.5	26.9
40	39.8	39.6	39.2	38.8	38.3	37.8	37.1	36.5	35.8	35.0	34.3	33.5	32.8	32.0	31.2	30.5	29.7	29.0	28.3
42	41.8	41.5	41.2	40.7	40.2	39.6	39.0	38.3	37.6	36.8	36.0	35.2	34.4	33.6	32.8	32.0	31.2	30.4	29.7
44	43.8	43.5	43.1	42.7	42.1	41.5	40.9	40.1	39.4	38.6	37.7	37.9	36.0	35.2	34.4	33.5	32.7	31.9	31.1
46	45.8	45.5	45.1	44.6	44.1	43.4	42.7	41.9	41.1	40.3	39.4	38.6	37.7	36.8	35.9	35.0	34.2	33.3	32.5
48	47.8	47.5	47.1	46.6	46.0	45.3	44.6	43.8	42.9	42.1	41.2	40.2	39.3	38.4	37.5	36.6	35.7	34.8	33.9
50	49.8	49.4	49.0	48.5	47.9	47.2	46.4	45.6	44.7	43.8	42.9	41.9	41.0	40.0	39.0	38.1	37.2	36.2	35.4
52	51.7	51.4	51.0	50.4	49.8	49.1	48.3	47.4	46.5	45.6	44.6	43.6	42.6	41.6	40.6	39.6	38.7	37.7	36.8
54	53.7	53.4	53.0	52.4	51.7	51.0	50.1	49.2	48.3	47.3	46.3	45.3	44.2	43.2	42.2	41.1	40.1	39.1	38.2
56	55.7	55.4	54.9	54.3	53.6	52.9	52.0	51.1	50.1	49.1	48.0	47.0	45.9	44.8	43.7	42.7	41.6	40.6	39.6
58	57.7	57.4	56.9	56.3	55.6	54.7	53.9	52.9	51.9	50.8	49.7	48.6	47.5	46.4	45.3	44.2	43.1	42.0	41.0
60	59.7	59.3	58.8	58.2	57.5	56.6	55.7	54.7	53.7	52.6	51.4	50.3	49.1	48.0	46.8	45.7	44.6	43.5	42.4
62	61.7	61.3	60.8	60.1	59.4	58.5	57.6	56.5	55.5	54.3	53.2	52.0	50.8	49.6	48.4	47.2	46.1	44.9	43.8
64	63.7	63.3	62.8	62.1	61.3	60.4	59.4	58.4	57.2	56.1	54.9	53.7	52.4	51.2	50.0	48.8	47.6	46.4	45.3
66	65.7	65.3	64.7	64.0	63.2	62.3	61.3	60.2	59.0	57.8	56.6	55.3	54.1	52.8	51.5	50.3	49.1	47.8	46.7
68	67.7	67.2	66.7	66.0	65.1	64.2	63.1	62.0	60.8	59.6	58.3	57.0	55.7	54.4	53.1	51.8	50.5	49.3	48.1
70	69.7	69.2	68.6	67.9	67.0	66.1	65.0	63.8	62.6	61.3	60.0	58.7	57.3	56.0	54.7	53.3	52.0	50.7	49.5
72	71.6	71.2	70.6	69.9	69.0	68.0	66.9	65.7	64.4	63.1	61.7	60.4	59.0	57.6	56.2	54.9	53.5	52.2	50.9
74	73.6	73.2	72.6	71.8	70.9	69.8	68.7	67.5	66.2	64.8	63.5	62.0	60.6	59.2	57.8	56.4	55.0	53.6	52.3
76	75.6	75.2	74.5	73.7	72.8	71.7	70.6	69.3	68.0	66.6	65.2	63.7	62.3	60.8	59.3	57.9	56.5	55.1	53.7
78	77.6	77.1	76.5	75.7	74.7	73.6	72.4	71.1	69.8	68.3	66.9	65.4	63.9	62.4	60.9	59.4	58.0	56.5	55.2
80	79.6	79.1	78.4	77.6	76.6	75.5	74.3	73.0	71.6	70.1	68.6	67.1	65.5	64.0	62.5	61.0	59.5	58.0	56.6
82	81.6	81.1	80.4	79.6	78.5	77.4	76.1	74.8	73.3	71.9	70.3	68.8	67.2	65.6	64.0	62.5	61.0	59.4	58.0
84	83.6	83.1	82.4	81.5	80.5	79.3	78.0	76.6	75.1	73.6	72.0	70.4	68.8	67.2	65.6	64.0	62.4	60.9	59.4
86	85.6	85.0	84.3	83.4	82.4	81.2	79.9	78.4	76.9	75.4	73.7	72.1	70.4	68.8	67.1	65.5	53.9	62.3	60.8
88	87.6	87.0	86.3	85.4	84.3	83.1	81.7	80.2	78.7	77.1	75.5	73.8	72.1	70.4	68.7	67.0	65.4	63.8	62.2
90	89.6	89.0	88.3	87.3	86.2	85.0	83.6	82.1	80.5	78.9	77.2	75.5	73.7	72.0	70.3	68.6	66.9	65.2	63.6
92	91.5	91.0	90.2	89.3	88.1	86.8	85.4	83.9	82.3	80.6	78.9	77.1	75.4	73.6	71.8	70.1	68.4	66.7	65.1
94	93.5	93.0	92.2	91.2	90.0	88.7	87.3	85.7	84.1	82.4	80.6	78.8	77.0	75.2	73.4	71.6	69.9	68.1	66.5
96	95.5	94.9	94.1	93.1	92.0	90.6	89.1	87.5	85.9	84.1	82.3	80.5	78.6	76.8	75.0	73.1	71.4	69.6	67.9
98	97.5	96.9	96.1	95.1	93.9	92.5	91.0	89.4	87.7	85.9	84.0	82.2	80.3	78.4	76.5	74.7	72.8	71.0	69.3
100	99.5	98.9	98.1	97.0	95.8	94.4	92.8	91.2	89.4	87.6	85.7	83.8	81.9	80.0	78.1	76.2	74.3	72.5	70.7

Table IX.—EQUIVALENTS OF PERCENTS IN DEGREES

Per cent	Degrees	Per cent	Degrees	Per cent	Degrees	Per cent	Degrees
	° ′		° ′		° ′		° ′
1	34	26	14 34	51	27 01	76	37 14
2	1 09	27	15 07	52	27 28	77	37 36
3	1 43	28	15 39	53	27 55	78	37 57
4	2 17	29	16 10	54	28 22	79	38 19
5	2 52	30	16 42	55	28 49	80	38 40
6	3 26	31	17 13	56	29 15	81	39 00
7	4 00	32	17 45	57	29 41	82	39 21
8	4 34	33	18 16	58	30 07	83	39 42
9	5 09	34	18 47	59	30 32	84	40 02
10	5 43	35	19 17	60	30 58	85	40 22
11	6 17	36	19 48	61	31 23	86	40 42
12	6 51	37	20 18	62	31 48	87	41 01
13	7 24	38	20 48	63	32 13	88	41 21
14	7 58	39	21 18	64	32 37	89	41 40
15	8 32	40	21 48	65	33 01	90	41 59
16	9 05	41	22 18	66	33 25	91	42 18
17	9 39	42	22 47	67	33 49	92	42 37
18	10 12	43	23 16	68	34 13	93	42 55
19	10 45	44	23 45	69	34 36	94	43 14
20	11 19	45	24 14	70	35 00	95	43 32
21	11 52	46	24 42	71	35 22	96	43 50
22	12 24	47	25 10	72	35 45	97	44 08
23	12 57	48	25 38	73	36 08	98	44 25
24	13 30	49	26 06	74	36 30	99	44 43
25	14 02	50	26 34	75	36 52	100	45 00

Table X.—EQUIVALENTS OF DEGREES IN PERCENTS

Degrees	Percent	Degrees	Percent	Degrees	Percent	Degrees	Percent
1	1.74	16	28.67	31	60.09	46	103.55
2	3.49	17	30.57	32	62.49	47	107.24
3	5.24	18	32.49	33	64.94	48	111.06
4	6.99	19	34.43	34	67.45	49	115.04
5	8.75	20	36.40	35	70.02	50	119.18
6	10.51	21	38.39	36	72.65	51	123.49
7	12.28	22	40.40	37	75.35	52	127.99
8	14.05	23	42.45	38	78.13	53	132.70
9	15.84	24	44.52	39	80.98	54	137.64
10	17.63	25	46.63	40	83.91	55	142.81
11	19.44	26	48.77	41	86.93	56	148.26
12	21.26	27	50.95	42	90.04	57	153.99
13	23.09	28	53.17	43	93.25	58	160.03
14	24.93	29	55.43	44	96.57	59	166.43
15	26.80	30	57.73	45	100.00	60	173.20

Table XI.—STADIA REDUCTIONS—HORIZONTAL DISTANCES AND ELEVATIONS FROM STADIA READINGS

Minutes	0°		1°		2°		3°	
	Hor. Dist.	Diff. Elev.	Hor. Dist.	Diff. Elev.	Hor. Dist.	Diff. Elev.	Hor. Dist.	Diff. Elev.
0	100.00	0.00	99.97	1.74	99.88	3.49	99.73	5.23
2	100.00	0.06	99.97	1.80	99.87	3.55	99.72	5.28
4	100.00	0.12	99.97	1.86	99.87	3.60	99.71	5.34
6	100.00	0.17	99.96	1.92	99.87	3.66	99.71	5.40
8	100.00	0.23	99.96	1.98	99.86	3.72	99.70	5.46
10	100.00	0.29	99.96	2.04	99.86	3.78	99.69	5.52
12	100.00	0.35	99.96	2.09	99.85	3.84	99.69	5.57
14	100.00	0.41	99.95	2.15	99.85	3.90	99.68	5.63
16	100.00	0.47	99.95	2.21	99.84	3.95	99.68	5.69
18	100.00	0.52	99.95	2.27	99.84	4.01	99.67	5.75
20	100.00	0.58	99.95	2.33	99.83	4.07	99.66	5.80
22	100.00	0.64	99.94	2.38	99.83	4.13	99.66	5.86
24	100.00	0.70	99.94	2.44	99.82	4.18	99.65	5.92
26	99.99	0.76	99.94	2.50	99.82	4.24	99.64	5.98
28	99.99	0.81	99.93	2.56	99.81	4.30	99.63	6.04
30	99.99	0.87	99.93	2.62	99.81	4.36	99.63	6.09
32	99.99	0.93	99.93	2.67	99.80	4.42	99.62	6.15
34	99.99	0.99	99.93	2.73	99.80	4.48	99.62	6.21
36	99.99	1.05	99.92	2.79	99.79	4.53	99.61	6.27
38	99.99	1.11	99.92	2.85	99.79	4.59	99.60	6.33
40	99.99	1.16	99.92	2.91	99.78	4.65	99.59	6.38
42	99.99	1.22	99.91	2.97	99.78	4.71	99.59	6.44
44	99.98	1.28	99.91	3.02	99.77	4.76	99.58	6.50
46	99.98	1.34	99.90	3.08	99.77	4.82	99.57	6.56
48	99.98	1.40	99.90	3.14	99.76	4.88	99.56	6.61
50	99.98	1.45	99.90	3.20	99.76	4.94	99.56	6.67
52	99.98	1.51	99.89	3.26	99.75	4.99	99.55	6.73
54	99.98	1.57	99.89	3.31	99.74	5.05	99.54	6.78
56	99.97	1.63	99.89	3.37	99.74	5.11	99.53	6.84
58	99.97	1.69	99.88	3.43	99.73	5.17	99.52	6.90
60	99.97	1.74	99.88	3.49	99.73	5.23	99.51	6.96
C=0.75	0.75	0.01	0.75	0.02	0.75	0.03	0.75	0.05
C=1.00	1.00	0.01	1.00	0.03	1.00	0.04	1.00	0.06
C=1.25	1.25	0.02	1.25	0.03	1.25	0.05	1.25	0.08

Table XI.—STADIA REDUCTIONS—HORIZONTAL DISTANCES AND ELEVATIONS FROM STADIA READINGS—Continued

Minutes	4°		5°		6°		7°	
	Hor. Dist.	Diff. Elev.	Hor. Dist.	Diff. Elev.	Hor. Dist.	Diff. Elev.	Hor. Dist.	Diff. Elev.
0	99.51	6.96	99.24	8.68	98.91	10.40	98.51	12.10
2	99.51	7.02	99.23	8.74	98.90	10.45	98.50	12.15
4	99.50	7.07	99.22	8.80	98.88	10.51	98.48	12.21
6	99.49	7.13	99.21	8.85	98.87	10.57	98.47	12.26
8	99.48	7.19	99.20	8.91	98.86	10.62	98.46	12.32
10	99.47	7.25	99.19	8.97	98.85	10.68	98.44	12.38
12	99.46	7.30	99.18	9.03	98.83	10.74	98.43	12.43
14	99.46	7.36	99.17	9.08	98.82	10.79	98.41	12.49
16	99.45	7.42	99.16	9.14	98.81	10.85	98.40	12.55
18	99.44	7.48	99.15	9.20	98.80	10.91	98.39	12.60
20	99.43	7.53	99.14	9.25	98.78	10.96	98.37	12.66
22	99.42	7.59	99.13	9.31	98.77	11.02	98.36	12.72
24	99.41	7.65	99.11	9.37	98.76	11.08	98.34	12.77
26	99.40	7.71	99.10	9.43	98.74	11.13	98.33	12.83
28	99.39	7.76	99.09	9.48	98.73	11.19	98.31	12.88
30	99.38	7.82	99.08	9.54	98.72	11.25	98.29	12.94
32	99.38	7.88	99.07	9.60	98.71	11.30	98.28	13.00
34	99.37	7.94	99.06	9.65	98.69	11.36	98.27	13.05
36	99.36	7.99	99.05	9.71	98.68	11.42	98.25	13.11
38	99.35	8.05	99.04	9.77	98.67	11.47	98.24	13.17
40	99.34	8.11	99.03	9.83	98.65	11.53	98.22	13.22
42	99.33	8.17	99.01	9.88	98.64	11.59	98.20	13.28
44	99.32	8.22	99.00	9.94	98.63	11.64	98.19	13.33
46	99.31	8.28	98.99	10.00	98.61	11.70	98.17	13.39
48	99.30	8.34	98.98	10.05	98.60	11.76	98.16	13.45
50	99.29	8.40	98.97	10.11	98.58	11.81	98.14	13.50
52	99.28	8.45	98.96	10.17	98.57	11.87	98.13	13.56
54	99.27	8.51	98.94	10.22	98.56	11.93	98.11	13.61
56	99.26	8.57	98.93	10.28	98.54	11.98	98.10	13.67
58	99.25	8.63	98.92	10.34	98.53	12.04	98.08	13.73
60	99.24	8.68	98.91	10.40	98.51	12.10	98.06	13.78
C=0.75	0.75	0.06	0.75	0.07	0.75	0.08	0.74	0.10
C=1.00	1.00	0.08	0.99	0.09	0.99	0.11	0.99	0.13
C=1.25	1.25	0.10	1.24	0.11	1.24	0.14	1.24	0.16

Table XI.—STADIA REDUCTIONS—HORIZONTAL DISTANCES AND ELEVATIONS FROM STADIA READINGS—Continued

Minutes	8°		9°		10°		11°	
	Hor. dist.	Diff. elev.	Hor. dist.	Diff. elev.	Hor. dist.	Diff. elev.	Hor. dist.	Diff. elev.
0	98.06	13.78	97.55	15.45	96.98	17.10	96.36	18.73
2	98.05	13.84	97.53	15.51	96.96	17.16	96.34	18.78
4	98.03	13.89	97.52	15.56	96.94	17.21	96.32	18.84
6	98.01	13.95	97.50	15.62	96.92	17.26	96.29	18.89
8	98.00	14.01	97.48	15.67	96.90	17.32	96.27	18.95
10	97.98	14.06	97.46	15.73	96.88	17.37	96.25	19.00
12	97.97	14.12	97.44	15.78	96.86	17.43	96.23	19.05
14	97.95	14.17	97.43	15.84	96.84	17.48	96.21	19.11
16	97.93	14.23	97.41	15.89	96.82	17.54	96.18	19.16
18	97.92	14.28	97.39	15.95	96.89	17.59	96.16	19.21
20	97.90	14.34	97.37	16.00	96.78	17.65	96.14	19.17
22	97.88	14.40	97.35	16.06	96.76	17.70	96.12	19.32
24	97.87	14.45	97.33	16.11	96.74	17.76	96.09	19.38
26	97.85	14.51	97.31	16.17	96.72	17.81	96.07	19.43
28	97.83	14.56	97.29	16.22	96.70	17.86	96.05	19.48
30	97.82	14.62	97.28	16.28	96.68	17.92	96.03	19.54
32	97.80	14.67	97.26	16.33	96.66	17.97	96.00	19.50
34	97.78	14.73	97.24	16.39	96.64	18.03	95.98	19.64
36	97.76	14.79	97.22	16.44	96.62	18.08	95.96	19.70
38	97.75	14.84	97.20	16.50	96.60	18.14	95.93	19.75
40	97.73	14.90	97.18	16.55	96.57	18.19	95.91	19.80
42	97.71	14.95	97.16	16.61	96.55	18.24	95.89	19.86
44	97.69	15.01	97.14	16.66	96.53	18.30	95.86	19.91
46	97.68	15.06	97.12	16.72	96.51	18.35	95.84	19.96
48	97.66	15.12	97.10	16.77	96.49	18.41	95.82	20.02
50	97.64	15.17	97.08	16.83	96.47	18.46	95.79	20.07
52	97.62	15.23	97.06	16.88	96.45	18.51	95.77	20.12
54	97.61	15.28	97.04	16.94	96.42	18.57	95.75	20.18
56	97.59	15.34	97.02	16.99	96.40	18.62	95.72	20.23
58	97.57	15.40	97.00	17.05	96.38	18.68	95.70	20.28
60	97.35	15.45	96.98	17.10	96.36	18.73	95.68	20.34
c=.75	0.74	0.11	0.74	0.12	0.74	0.14	0.73	0.15
c=1.00	0.99	0.15	0.99	0.16	0.98	0.18	0.98	0.20
c=1.25	1.23	0.18	1.23	0.21	1.23	0.23	1.22	0.25

Table XI.—STADIA REDUCTIONS—HORIZONTAL DISTANCES AND ELEVATIONS FROM STADIA READINGS—Continued

Minutes	12°		13°		14°		15°	
	Hor. dist.	Diff. elev.	Hor. dist.	Diff. elev.	Hor. dist.	Diff. elev.	Hor. dist.	Diff. elev.
0	95.68	20.34	94.94	21.92	94.15	23.47	93.30	25.00
2	95.65	20.39	94.91	21.97	94.12	23.52	93.27	25.05
4	95.63	20.44	94.89	22.02	94.09	23.58	93.24	25.10
6	95.61	20.50	94.86	22.08	94.07	23.63	93.21	25.15
8	95.58	20.55	94.84	22.13	94.04	23.68	93.18	25.20
10	95.56	20.60	94.81	22.18	94.01	23.73	93.16	25.25
12	95.53	20.66	94.79	22.23	93.98	23.78	93.13	25.30
14	95.51	20.71	94.76	22.28	93.95	23.83	93.10	25.35
16	95.49	20.76	94.73	22.34	93.93	23.88	93.07	25.40
18	95.46	20.81	94.71	22.39	93.90	23.93	93.04	25.45
20	95.44	20.87	94.68	22.44	93.87	23.99	93.01	25.50
22	95.41	20.92	94.66	22.49	93.84	24.04	92.98	25.55
24	95.39	20.97	94.63	22.54	93.81	24.09	92.95	25.60
26	95.36	21.03	94.60	22.60	93.79	24.14	92.92	25.65
28	95.34	21.08	94.58	22.65	93.76	24.19	92.89	25.70
30	95.32	21.13	94.55	22.70	93.73	24.24	92.86	25.75
32	95.29	21.18	94.52	22.75	93.70	24.29	92.83	25.80
34	95.27	21.24	94.50	22.80	93.67	24.34	92.80	25.85
36	95.24	21.29	94.47	22.85	93.65	24.39	92.77	25.90
38	95.22	21.34	94.44	22.91	93.62	24.44	92.74	25.95
40	95.19	21.39	94.42	22.96	93.59	24.49	92.71	26.00
42	95.17	21.45	94.39	23.01	93.56	24.55	92.68	26.05
44	95.14	21.50	94.36	23.06	93.53	24.60	92.65	26.10
46	95.12	21.55	94.34	23.11	93.50	24.65	92.62	26.15
48	95.09	21.60	94.31	23.16	93.47	24.70	92.59	26.20
50	95.07	21.66	94.28	23.22	93.45	24.75	92.56	26.25
52	95.04	21.71	94.26	23.27	93.42	24.80	92.53	26.30
54	95.02	21.77	94.23	23.32	93.39	24.85	92.49	26.35
56	94.99	21.81	94.20	23.37	93.36	24.90	92.46	26.40
58	94.97	21.87	94.17	23.42	93.33	24.95	92.43	26.45
60	94.94	21.92	94.15	23.47	93.30	25.00	92.40	26.50
c=0.75	0.73	0.16	0.73	0.17	0.73	0.19	0.72	0.20
c=1.00	0.98	0.22	0.97	0.23	0.97	0.25	0.96	0.27
c=1.25	1.22	0.27	1.21	0.29	1.21	0.31	1.20	0.34

Table XI.—STADIA REDUCTIONS—HORIZONTAL DISTANCES AND ELEVATIONS FROM STADIA READINGS—Continued

Minutes	16°		17°		18°		19°	
	Hor. dist.	Diff. elev.	Hor. dist.	Diff. elev.	Hor. dist.	Diff. elev.	Hor. dist.	Diff. elev.
0	92.40	26.50	91.45	27.96	90.45	29.39	89.40	30.78
2	92.37	26.55	91.42	28.01	90.42	29.44	89.36	30.83
4	92.34	26.59	91.39	28.06	90.38	29.48	89.33	30.87
6	92.31	26.64	91.35	28.10	90.35	29.53	89.29	30.92
8	92.28	26.69	91.32	28.15	90.31	29.58	89.26	30.97
10	92.25	26.74	91.29	28.20	90.28	29.62	89.22	31.01
12	92.22	26.79	91.26	28.25	90.24	29.67	89.18	31.06
14	92.19	26.84	91.22	28.30	90.21	29.72	89.15	31.10
16	92.15	26.89	91.19	28.34	90.18	29.76	89.11	31.15
18	92.12	26.94	91.16	28.39	90.14	29.81	89.08	31.19
20	92.09	26.99	91.12	28.44	90.11	29.86	89.04	31.24
22	92.06	27.04	91.09	28.49	90.07	29.90	89.00	31.28
24	92.03	27.09	91.06	28.54	90.04	29.95	88.96	31.33
26	92.00	27.13	91.02	28.58	90.00	30.00	88.93	31.38
28	91.97	27.18	90.99	28.63	89.97	30.04	88.89	31.42
30	91.93	27.23	90.96	28.68	89.93	30.09	88.86	31.47
32	91.90	27.28	90.92	28.73	89.90	30.14	88.82	31.51
34	91.87	27.33	90.89	28.77	89.86	30.19	88.78	31.56
36	91.84	27.38	90.86	28.82	89.83	30.23	88.75	31.60
38	91.81	27.43	90.82	28.87	89.79	30.28	88.71	31.65
40	91.77	27.48	90.79	28.92	89.76	30.32	88.67	31.69
42	91.74	27.52	90.76	28.96	89.72	30.37	88.64	31.74
44	91.71	27.57	90.72	29.01	89.69	30.41	88.60	31.78
46	91.68	27.62	90.69	29.06	89.65	30.46	88.56	31.83
48	91.65	27.67	90.66	29.11	89.61	30.51	88.53	31.87
50	91.61	27.72	90.62	29.15	89.58	30.55	88.49	31.92
52	91.58	27.77	90.59	29.20	89.54	30.60	88.45	31.96
54	91.55	27.81	90.55	29.25	89.51	30.65	88.41	32.01
56	91.52	27.86	90.52	29.30	89.47	30.69	88.38	32.05
58	91.48	27.91	90.48	29.34	89.44	30.74	88.34	32.09
60	91.45	27.96	90.45	29.39	89.40	30.78	88.30	32.14
c=0.75	0.72	0.21	0.72	0.23	0.71	0.24	0.71	0.25
c=1.00	0.96	0.28	0.95	0.30	0.95	0.32	0.94	0.33
c=1.25	1.20	0.35	1.19	0.38	1.19	0.40	1.18	0.42

Table XI.—STADIA REDUCTIONS—HORIZONTAL DISTANCES AND ELEVATIONS FROM STADIA READINGS—Continued

Minutes	20°		21°		22°		23°	
	Hor. dist.	Diff. elev.	Hor. dist.	Diff. elev.	Hor. dist.	Diff. elev.	Hor. dist.	Diff. elev.
0	88.30	32.14	87.16	33.46	85.97	34.73	84.73	35.97
2	88.26	32.18	87.12	33.50	85.93	34.77	84.69	36.01
4	88.23	32.23	87.08	33.54	85.89	34.82	84.65	36.05
6	88.19	32.27	87.04	33.59	85.85	34.86	84.61	36.09
8	88.15	32.32	87.00	33.63	85.80	34.90	84.57	36.13
10	88.11	32.36	86.96	33.67	85.76	34.94	84.52	36.17
12	88.08	32.41	86.92	33.72	85.72	34.98	84.48	36.21
14	88.04	32.45	86.88	33.76	85.68	35.02	84.44	36.25
16	88.00	32.49	86.84	33.80	85.64	35.07	84.40	36.29
18	87.96	32.54	86.80	33.84	85.60	35.11	84.35	36.33
20	87.93	32.58	86.77	33.89	85.56	35.15	84.31	36.37
22	87.89	32.63	86.73	33.93	85.52	35.19	84.27	36.41
24	87.85	32.67	86.69	33.97	85.48	35.23	84.23	36.45
26	87.81	32.72	86.65	34.01	85.44	35.27	84.18	36.49
28	87.77	32.76	86.61	34.06	85.40	35.31	84.14	36.53
30	87.74	32.80	86.57	34.10	85.36	35.36	84.10	36.57
32	87.70	32.85	86.53	34.14	85.31	35.40	84.06	36.61
34	87.66	32.89	86.49	34.18	85.27	35.44	84.01	36.65
36	87.62	32.93	86.45	34.23	85.23	35.48	83.97	36.69
38	87.58	32.98	86.41	34.27	85.19	35.52	83.93	36.73
40	87.54	33.02	86.37	34.31	85.15	35.56	83.89	36.77
42	87.51	33.07	86.33	34.35	85.11	35.60	83.84	36.80
44	87.47	33.11	86.29	34.40	85.07	35.64	83.80	36.84
46	87.43	33.15	86.25	34.44	85.02	35.68	83.76	36.88
48	87.39	33.20	86.21	34.48	84.98	35.72	83.72	36.92
50	87.35	33.24	86.17	34.52	84.94	35.76	83.67	36.96
52	87.31	33.28	86.13	34.57	84.90	35.80	83.63	37.00
54	87.27	33.33	86.09	34.61	84.86	35.85	83.59	37.04
56	87.24	33.37	86.05	34.65	84.82	35.89	83.54	37.08
58	87.20	33.41	86.01	34.69	84.77	35.93	83.50	37.12
60	87.16	33.46	85.97	34.73	84.73	35.97	83.46	37.16
c=0.75	0.70	0.26	0.70	0.27	0.69	0.29	0.69	0.30
c=1.00	0.94	0.35	0.93	0.37	0.92	0.38	0.92	0.40
c=1.25	1.17	0.44	1.16	0.46	1.15	0.48	1.15	0.50

Table XI.—STADIA REDUCTIONS—HORIZONTAL DISTANCES AND ELEVATIONS FROM STADIA READINGS—Continued

Minutes	24°		25°		26°		27°	
	Hor. dist.	Diff. elev.	Hor. dist.	Diff. elev.	Hor. dist.	Diff. elev.	Hor. dist.	Diff. elev.
0	83.46	37.16	82.14	38.30	80.78	39.40	79.39	40.45
2	83.41	37.20	82.09	38.34	80.74	39.44	79.34	40.49
4	83.37	37.23	82.05	38.38	80.69	39.47	79.30	40.52
6	83.33	37.27	82.01	38.41	80.65	39.51	79.25	40.55
8	83.28	37.31	81.96	38.45	80.60	39.54	79.20	40.59
10	83.24	37.35	81.92	38.49	80.55	39.58	79.15	40.62
12	83.20	37.39	81.87	38.53	80.51	39.61	79.11	40.66
14	83.15	37.43	81.83	38.56	80.46	39.65	79.06	40.69
16	83.11	37.47	81.78	38.60	80.41	39.69	79.01	40.72
18	83.07	37.51	81.74	38.64	80.37	39.72	78.96	40.76
20	83.02	37.54	81.69	38.67	80.32	39.76	78.92	40.79
22	82.98	37.58	81.65	38.71	80.28	39.79	78.87	40.82
24	82.93	37.62	81.60	38.75	80.23	39.83	78.82	40.86
26	82.89	37.66	81.56	38.78	80.18	39.86	78.77	40.89
28	82.85	37.70	81.51	38.82	80.14	39.90	78.73	40.92
30	82.80	37.74	81.47	38.86	80.09	39.93	78.68	40.96
32	82.76	37.77	81.42	38.89	80.04	39.97	78.63	40.99
34	82.72	37.81	81.38	38.93	80.00	40.00	78.58	41.02
36	82.67	37.85	81.33	38.97	79.95	40.04	78.54	41.06
38	82.63	37.89	81.28	39.00	79.90	40.07	78.49	41.09
40	82.58	37.93	81.24	39.04	79.86	40.11	78.44	41.12
42	82.54	37.96	81.19	39.08	79.81	40.14	78.39	41.16
44	82.49	38.00	81.15	39.11	79.76	40.18	78.34	41.19
46	82.45	38.04	81.10	39.15	79.72	40.21	78.30	41.22
48	82.41	38.08	81.06	39.18	79.67	40.24	78.25	41.26
50	82.36	38.11	81.01	39.22	79.62	40.28	78.20	41.29
52	82.32	38.15	80.97	39.26	79.58	40.31	78.15	41.32
54	82.27	38.19	80.92	39.29	79.53	40.35	78.10	41.35
56	82.23	38.23	80.87	39.33	79.48	40.38	78.06	41.39
58	82.18	38.26	80.83	39.36	79.44	40.42	78.01	41.42
60	82.14	38.30	80.78	39.40	79.39	40.45	77.96	41.45
c=0.75	0.68	0.31	0.68	0.32	0.67	0.33	0.66	0.35
c=1.00	0.91	0.41	0.90	0.43	0.89	0.45	0.89	0.46
c=1.25	1.14	0.52	1.13	0.54	1.12	0.56	1.11	0.58

Table XI.—STADIA REDUCTIONS—HORIZONTAL DISTANCES AND ELEVATIONS FROM STADIA READINGS—Concluded

Minutes	28°		29°		30°	
	Hor. dist.	Diff. elev.	Hor. dist.	Diff. elev.	Hor. dist.	Diff. elev.
0	77.96	41.45	76.50	42.40	75.00	43.30
2	77.91	41.48	76.45	42.43	74.95	43.33
4	77.86	41.52	76.40	42.46	74.90	43.36
6	77.81	41.55	76.35	42.49	74.85	43.39
8	77.77	41.58	76.30	42.53	74.80	43.42
10	77.72	41.61	76.25	42.56	74.75	43.45
12	77.67	41.65	76.20	42.59	74.70	43.47
14	77.62	41.68	76.15	42.62	74.65	43.50
16	77.57	41.71	76.10	42.65	74.60	43.53
18	77.52	41.74	76.05	42.68	74.55	43.56
20	77.48	41.77	76.00	42.71	74.49	43.59
22	77.42	41.81	75.95	42.74	74.44	43.62
24	77.38	41.84	75.90	42.77	74.39	43.65
26	77.33	41.87	75.85	42.80	74.34	43.67
28	77.28	41.90	75.80	42.83	74.29	43.70
30	77.23	41.93	75.75	42.86	74.24	43.73
32	77.18	41.97	75.70	42.89	74.19	43.76
34	77.13	42.00	75.65	42.92	74.14	43.79
36	77.09	42.03	75.60	42.95	74.09	43.82
38	77.04	42.06	75.55	42.98	74.04	43.84
40	76.99	42.09	75.50	43.01	73.99	43.87
42	76.94	42.12	75.45	43.04	73.93	43.90
44	76.89	42.15	75.40	43.07	73.88	43.93
46	76.84	42.19	75.35	43.10	73.83	43.95
48	76.79	42.22	75.30	43.13	73.78	43.98
50	76.74	42.25	75.25	43.16	73.73	44.01
52	76.69	42.28	75.20	43.18	73.68	44.04
54	76.64	42.31	75.15	43.21	73.63	44.07
56	76.59	42.34	75.10	43.24	73.58	44.09
58	76.55	42.37	75.05	43.27	73.52	44.12
60	76.50	42.40	75.00	43.30	73.47	44.15
c=0.75	0.66	0.36	0.65	0.37	0.65	0.38
c=1.00	0.88	0.48	0.87	0.49	0.86	0.51
c=1.25	1.10	0.60	1.09	0.62	1.08	0.64

ABNEY LEVEL—BUBBLE ADJUSTMENT

Select two trees or other objects about 100 feet apart on nearly level ground, as *X* and *Y* in figure. Set a mark *a* at *X*; then move to *Y*. Set the index arm of the Abney at 0 and sight *a* from *Y*; move the Abney up and down at *Y* until some point *b* is found which apparently is on a level line through *a*. Mark point *b*.

Now move to *X* and sight *b*. Move the Abney up and down at *X* until some point *c* is found which apparently is on a level line through *b*. Mark point *c*. Set a point *d* midway between *a* and *c*. Line *db* is level. Adjust the level bubble until (with the index arm reading zero) the bubble will show level when the instrument is sighted from *d* to *b*.

As a final test, read up and down between two definite objects on a steep slope (30 to 45 percent). If both readings are identical, the instrument is in good adjustment.

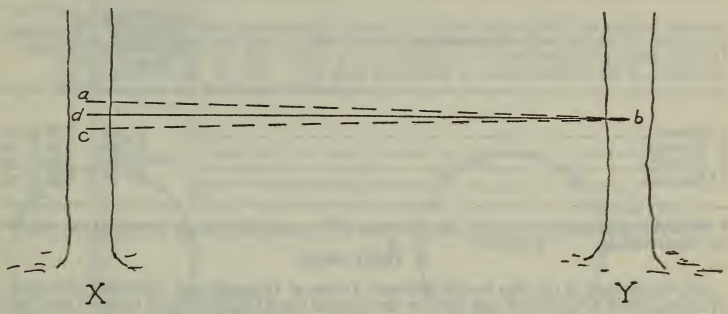
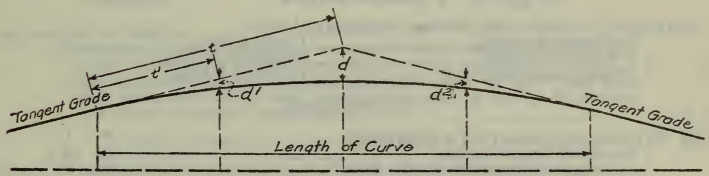


FIGURE 7.

"VERTICAL CURVES"



FORMULAE

A. Difference in elevation (*d*) at center of curve expressed in feet = ½ (algebraic difference of the tangent grades expressed in feet per 100) × (length of curve expressed in stations of 100 feet).

B. Intermediate difference of elevations between tangent grades and point on vertical curve.

$$d' : d :: t'^2 : t^2$$

$$d' = \frac{dt'^2}{t^2}$$

FIGURE 8.

To illustrate the use of this method, the following example is used:

Date of observation, September 15, 1927.

Latitude, 47°8½′; longitude, 115°52½′; both derived from ¼-inch Forest map by interpolation.

Watch is adjusted to standard time of the one hundred and fifth meridian (mountain time).

FIELD WORK

From a transit station on the surveyed line a reference line is established to the west of the star. (See fig. 11.) From this the following observations are made:

Observation	Horizontal angle star to reference point	Standard time
	° ′	
1. Direct	3 49	7.38 p. m.
2. Reverse	3 47	7.46 p. m.
3. Direct	3 46	7.50 p. m.
4. Reverse	3 47	7.54 p. m.

With this information available the following office computations are necessary to complete the observation:

1. *Tables needed*

(*a*) "Ephemeris of the Sun and Polaris and Tables of Azimuths and Altitudes of Polaris." (This pamphlet is published each year by the General Land Office; also it is believed that most instrument manufacturers publish a pocket "Ephemeris" each year which includes tables of azimuths for hour angles.)

(*b*) Correction tables for longitude (siderial conversion table), included in this book, page 37.

2. *Longitude and time*

The following relation exists between longitude and time:

15° longitude equals ---------- 1 hour of time.
1° longitude equals ---------- 4 minutes of time.
1′ longitude equals ---------- 4 seconds of time.

3. *Computations*

	°	′		
(*a*) To obtain local mean time of observation:				
Longitude of observation	115	52.5		
Longitude of mountain (watch) time	105	0		
Difference in longitude	10	52.5		
Multiply by 4 (see 2, Longitude and time)	4	4		
Difference in time			43^m	30^s =43.5^m
Standard time of observation, 1 (*d*)			7^h	38.0^m
(Watch is faster than local mean time) minus*				−43.5
Local mean time of observation, 1 (*d*)			6^h	54.5^m

*Add when observation is east of meridian to which watch is set.

(*b*) Hour angle:

	°	′
Local mean time of upper culmination at Greenwich Sept. 15, 1927	2^h	4.1^m a. m.
Time correction subtracted from Greenwich local mean time (table of Siderial Conversions)		−1.2
Local mean time of upper culmination on Sept. 15, 1927	2^h	2.9^m a. m.
Local mean time of observation 1 (*d*), Sept. 15, 1927	6^h	54.5^m p. m.
	+12	00.0
Hour angle at observation 1 (*d*) (see fig. 9)	16^h	51.6^m

FIGURE 9.—From 2^h 2.9^m a. m. until 2^h 2.9^m p. m. equals 12 hours; from 2^h 2.9^m p.m. until time of observation 6^h 54.5^m p. m. equals 4^h 51.6^m plus 12 hours equals 16^h 51.6^m hour angle.

(*c*) Time argument:

To obtain time argument consult figure 10. If the hour angle (time elapsed between upper culmination and time of observation) is less than 11^h 58^m the star is west of the meridian; if greater the star is east of the meridian. If hour angle is greater than 11^h 58^m subtract from 23^h 56^m. The time argument at observation 1 (*d*) is, therefore, 23^h 56^m minus 16^h 51.6^m equals 7^h $04\frac{1}{2}^m$.

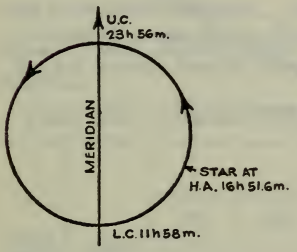


FIGURE 9.

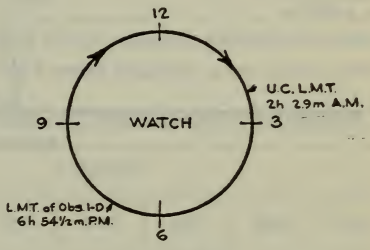


FIGURE 10.

(*d*) Azimuth of Polaris:

Use time argument 7^h $04\frac{1}{2}^m$ and latitude 47° 8½′ N. in hour angle table in back of Ephemeris and by interpolation obtain azimuth	1°	31′
From Ephemeris for date Sept. 15, 1927, obtain +88° 54′ 44.99″ and with time argument 7^h $04\frac{1}{2}^m$ refer to angle hour table in back of Ephemeris and obtain correction (additive)		+0.2′
Azimuth of Polaris at observation 1 (*d*) is	1°	31.2′

From the field observations and computations we then have the following:

Observation	Standard time		Local mean time		Hour angle		Time argument		Azimuth	
	h	*m*	*h*	*m*	*h*	*m*	*h*	*m*	°	′
1. Direct	7	38	6	54½	16	51½	7	04½	1	31
2. Reverse	7	46	7	2½	16	59½	6	56½	1	32
3. Direct	7	50	7	6½	17	3½	6	52½	1	32½
4. Reverse	7	54	7	10½	17	7½	6	48½	1	33

Observation	Angle	Azimuth of star	Bearing of reference line
	° ′	° ′	
1. Direct	3 49	1 31	N. 2° 18′ W.
2. Reverse	3 47	1 32	N. 2° 15′ W.
3. Direct	3 46	1 32½	N. 2° 13½′ W.
4. Reverse	3 47	1 33	N. 2° 14′ W.
Mean (see fig. 11)	3 47	1 32	N. 2° 15′ W.

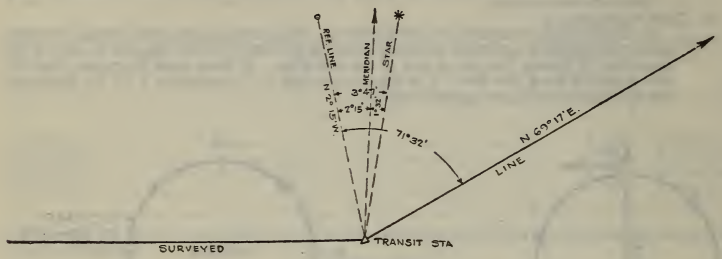


FIGURE 11.

OBSERVATION OF POLARIS AT ELONGATION

EXAMPLE.—Date, May 2, 1927; latitude, 46°32′ N.; longitude, 110°36′ W. Latitude and longitude derived from ¼-inch Forest map by interpolation.

Mean time of eastern elongation at Greenwich, May 2, 1927		$5^h\ 1.3^m$ a. m.
Correction (subtractive) for longitude 110°36′ from table of Siderial Conversions		1.2^m
Time of eastern elongation, corrected for longitude, May 2, 1927		$5^h\ 0.1^m$ a. m.
Correction to time of elongation, latitude 46°32′ N. (additive)		1.0^m
Local mean time of eastern elongation, May 2, 1927		$5^h\ 1.1^m$ a. m.
Longitude of observation	110° 36′ W.	
Longitude of Mountain (watch) time	105 0 W.	
Difference in longitude	5° 36′	
Relation of longitude to time, multiply by 4	4 4	
Difference in time	22^m 24^s =	22.4^m
Local mean time of eastern elongation		$5^h\ 1.1^m$ a. m.
Watch is fast of local mean time		$+22.4^m$
Local watch time of observation		$5^h\ 23.5^m$ a. m.

Interpolating in Ephemeris for latitude 46°32′ N. and declination +88°54′40.45″=1°34′58″ equals N. 1°35′ E. azimuth of Polaris.

For true meridian, therefore, lay off to left if eastern elongation and to right if western elongation.

Table XII.—CORRECTIONS FOR SIDEREAL CONVERSIONS

Longitude	Hours	Longitude 0°0′	2°30′	5°0′	7°30′	10°0′	12°30′	15°0′
		Minutes 0	10	20	30	40	50	60
°		m s	m s	m s	m s	m s	m s	m s
60	4	0 39	0 41	0 43	0 44	0 46	0 48	0 49
75	5	0 49	0 51	0 53	0 54	0 56	0 57	0 59
90	6	0 59	1 1	1 2	1 4	1 6	1 7	1 9
105	7	1 9	1 11	1 12	1 14	1 15	1 17	1 19
120	8	1 19	1 20	1 22	1 24	1 25	1 27	1 29
135	9	1 29	1 30	1 32	1 34	1 35	1 37	1 38
150	10	1 38	1 40	1 42	1 43	1 45	1 47	1 48

Sidereal into mean solar time, to be subtracted from a sidereal time interval: Argument hours and minutes of sidereal interval.

Mean solar into sidereal time, to be added to a mean time interval: Argument hours and minutes of mean time interval.

Upper culmination of Polaris, amount to be subtracted from the Greenwich mean time of upper culmination of Polaris, or of elongation, to obtain the local mean time of upper culmination, or of elongation: Argument longitude west from Greenwich.

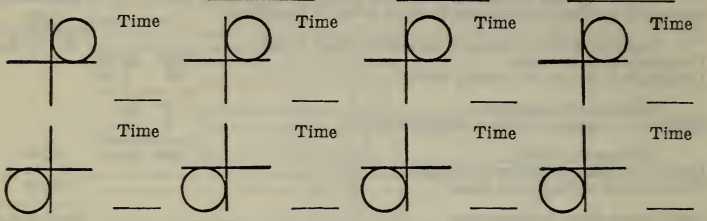
The above table is an abridged mean of two tables given in the American Ephemeris and Nautical Almanac for similar conversions; reductions involving a refinement exceeding 0.8 second must be made from the more elaborate tables.

MERIDIAN BY SOLAR OBSERVATION

$$\text{Cos } A = \frac{\text{Sin } D}{\text{Cos } L \text{ Cos } H} - (\text{Tan } L \text{ Tan } H)$$

A = Sun's Azimuth
D = Declination
H = Altitude corrected for refraction
L = Latitude

Set 1, Direct | *Set 2, Reversed* | *Set 3, Direct* | *Set 4, Reversed*



	Hor.<s	Vert.<s	Hor.<s	Vert.<s	Hor.<s	Vert.<s	Hor.<s	Vert.<s
1. Readings								
2. Readings								
Sums								
Mean								
Refraction								
Trus alt. H								
Declination								
Log sin D								
Log cos L								
Diff.								
Log cos H								
Log first term								
First term								
Log tan L								
Log second term								
Second term								
Nat cos A								
Angle A								
Brg. of sun								
Brg. of ref. pt								

NOTE.—When sum of terms is positive A is angle between sun and N point, when sum is negative A refers to S point.

Table XIII.—TRIGONOMETRIC FORMULAS FOR THE SOLUTION OF PLANE TRIANGLES

Let A=angle BAC=arc BF, and let the radius $AF=AB=AH=1$.
We then have

Sin A $=BC$
Cos A $=AC$
Tan A $=DF$
Cot A $=HG$
Sec A $=AD$
Cosec A $=AG$
Versin A $=CF=BE$
Covers A $=BK=HL$
Exsec A $=BD$
Coexsec $A=BG$
Chord A $=BF$
Chord $2A=BI=2BC$

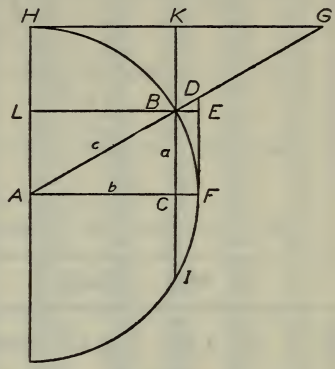


FIGURE 12.

In the right-angled triangle ABC
Let $AB=c$, $AC=b$, and $BC=a$.
We then have:

1. Sin A $=\frac{a}{c}=\cos B$
2. Cos A $=\frac{b}{c}=\sin B$
3. Tan A $=\frac{a}{b}=\cot B$
4. Cot A $=\frac{b}{a}=\tan B$
5. Sec A $=\frac{c}{b}=\operatorname{cosec} B$
6. Cosec A $=\frac{c}{a}=\sec B$
7. Vers A $=\frac{c-b}{c}=\operatorname{covers} B$
8. Exsec A $=\frac{c-b}{b}=\operatorname{coexsec} B$
9. Covers A $=\frac{c-a}{c}=\operatorname{versin} B$
10. Coexsec $A=\frac{c-a}{a}=\operatorname{exsec} B$
11. $a=c\sin A=b\tan A$
12. $b=c\cos A=a\cot A$
13. $c=\frac{a}{\sin A}=\frac{b}{\cos A}$
14. $a=c\cos B=b\cot B$
15. $b=c\sin B=a\tan B$
16. $c=\frac{a}{\cos B}=\frac{b}{\sin B}$
17. $a=\sqrt{(c+b)(c-b)}$
18. $b=\sqrt{(c+a)(c-a)}$
19. $c=\sqrt{a^2+b^2}$
20. $C=90°=A+B$
21. Area $=\frac{ab}{2}$

Table XIII.—TRIGONOMETRIC FORMULAS FOR THE SOLUTION OF PLANE TRIANGLES

SOLUTION OF OBLIQUE TRIANGLES

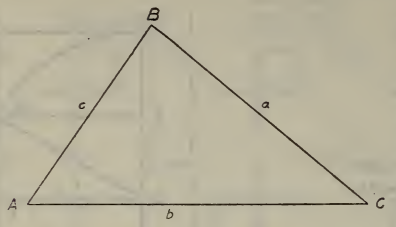


FIG. 13

	Given	Sought	Formula
22	A, B, a	C, b, c	$C=180°-(A+B)$, $b=\frac{a}{\sin A}\cdot\sin B$, $c=\frac{a}{\sin A}\sin(A+B)$
23	A, a, b	B, C, c	$\sin B=\frac{\sin A}{a}\cdot b$, $C=180°-(A+B)$, $c=\frac{a}{\sin A}\cdot\sin C$
24	C, a, b	$\frac{1}{2}(A+B)$	$\frac{1}{2}(A+B)=90°-\frac{1}{2}C$
25		$\frac{1}{2}(A-B)$	$\tan\frac{1}{2}(A-B)=\frac{a-b}{a+b}\tan\frac{1}{2}(A+B)$
26		A, B	$A=\frac{1}{2}(A+B)+\frac{1}{2}(A-B)$, $B=\frac{1}{2}(A+B)-\frac{1}{2}(A-B)$
27		c	$c=(a+b)\frac{\cos\frac{1}{2}(A+B)}{\cos\frac{1}{2}(A-B)}=\sqrt{a^2+b^2-2ab\cos C}$
28		Area	Area$=\frac{1}{2}ab\sin C$
29	a, b, c	A	Let $s=\frac{1}{2}(a+b+c)$; $\sin\frac{1}{2}A=\sqrt{\frac{(s-b)(s-c)}{bc}}$
30			$\cos\frac{1}{2}A=\sqrt{\frac{s(s-a)}{bc}}$; $\tan\frac{1}{2}A=\sqrt{\frac{(s-b)(s-c)}{s(s-a)}}$
31			$\sin A=\frac{2\sqrt{s(s-a)(s-b)(s-c)}}{bc}$; $\cos A=\frac{b^2+c^2-a^2}{2bc}$
32		Area	Area$=\sqrt{s(s-a)(s-b)(s-c)}$
33	A, B, C, a	Area	Area$=\frac{a^2\sin B.\sin C}{2\sin A}$

Table XIV.—NATURAL SINES AND COSINES

M.	0°		1°		2°		3°		4°		
	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	
0	0.00000	1.0000	0.01745	0.99985	0.03490	0.99939	0.05234	0.99863	0.06976	0.99756	60
1	029	000	774	984	519	938	263	861	.07005	754	59
2	058	000	803	984	548	937	292	860	034	752	58
3	087	000	832	983	577	936	321	858	063	750	57
4	116	000	862	983	606	935	350	857	092	748	56
5	.00145	1.0000	.01891	.99982	.03635	.99934	.05379	.99855	.07121	.99746	55
6	175	000	920	982	664	933	408	854	150	744	54
7	204	000	949	981	693	932	437	852	179	742	53
8	233	000	978	980	723	931	466	851	208	740	52
9	262	000	.02007	980	752	930	495	849	237	738	51
10	.00291	1.0000	.02036	.99979	.03781	.99929	.05524	.99847	.07266	.99736	50
11	320	.99999	065	979	810	927	553	846	295	734	49
12	349	999	094	978	839	926	582	844	324	731	48
13	378	999	123	977	868	925	611	842	353	729	47
14	407	999	152	977	897	924	640	841	382	727	46
15	.00436	.99999	.02181	.99976	.03926	.99923	.05669	.99839	.07411	.99725	45
16	465	999	211	976	955	922	698	838	440	723	44
17	495	999	240	975	984	921	727	836	469	721	43
18	524	999	269	974	.04013	919	756	834	498	719	42
19	553	998	298	974	042	918	785	833	527	716	41
20	.00582	.99998	.02327	.99973	.04071	.99917	.05814	.99831	.07556	.99714	40
21	611	998	356	972	100	916	844	829	585	712	39
22	640	998	385	972	129	915	873	827	614	710	38
23	669	998	414	971	159	913	902	826	643	708	37
24	698	998	443	970	188	912	931	824	672	705	36
25	.00727	.99997	.02472	.99969	.04217	.99911	.05960	.99822	.07701	.99703	35
26	756	997	501	969	246	910	989	821	730	701	34
27	785	997	530	968	275	909	.06018	819	759	699	33
28	814	997	560	967	304	907	047	817	788	696	32
29	844	996	589	966	333	906	076	815	817	694	31
30	.00873	.99996	.02618	.99966	.04362	.99905	.06105	.99813	.07846	.99692	30
31	902	996	647	965	391	904	134	812	875	689	29
32	931	996	676	964	420	902	163	810	904	687	28
33	960	995	705	963	449	901	192	808	933	685	27
34	989	995	734	963	478	900	221	806	962	683	26
35	.01018	.99995	.02763	.99962	.04507	.99898	.06250	.99804	.07991	.99680	25
36	047	995	792	961	536	897	279	803	.08020	678	24
37	076	994	821	960	565	896	308	801	049	676	23
38	105	994	850	959	594	894	337	799	078	673	22
39	134	994	879	959	623	893	366	797	107	671	21
40	.01164	.99993	.02908	.99958	.04653	.99892	.06395	.99795	.08136	.99668	20
41	193	993	938	957	682	890	424	793	165	666	19
42	222	993	967	956	711	889	453	792	194	664	18
43	251	992	996	955	740	888	482	790	223	661	17
44	280	992	.03025	954	769	886	511	788	252	659	16
45	.01309	.99991	.03054	.99953	.04798	.99885	.06540	.99786	.08281	.99657	15
46	338	991	083	952	827	883	569	784	310	654	14
47	367	991	112	952	856	882	598	782	339	652	13
48	396	990	141	951	885	881	627	780	368	649	12
49	425	990	170	950	914	879	656	778	397	647	11
50	.01454	.99989	.03199	.99949	.04943	.99878	.06685	.99776	.08426	.99644	10
51	483	989	228	948	972	876	714	774	455	642	9
52	513	989	257	947	.05001	875	743	772	484	639	8
53	542	988	286	946	030	873	773	770	513	637	7
54	571	988	316	945	059	872	802	768	542	635	6
55	.01600	.99987	.03345	.99944	.05088	.99870	.06831	.99766	.08571	.99632	5
56	629	987	374	943	117	869	860	764	600	630	4
57	658	986	403	942	146	867	889	762	629	627	3
58	687	986	432	941	175	866	918	760	658	625	2
59	716	985	461	940	205	864	947	758	687	622	1
60	.01745	.99985	.03490	.99939	.05234	.99863	.06976	.99756	.08716	.99619	0
	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	M.
	89°		88°		87°		86°		85°		

Table XIV.—NATURAL SINES AND COSINES—Continued

M.	5°		6°		7°		8°		9°		
	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	
0	0.08716	0.99619	0.10453	0.99452	0.12187	0.99255	0.13917	0.99027	0.15643	0.98769	60
1	745	617	482	449	216	251	946	023	672	764	59
2	774	614	511	446	245	248	975	019	701	760	58
3	803	612	540	443	274	244	.14004	015	730	755	57
4	831	609	569	440	302	240	033	011	758	751	56
5	.08860	.99607	.10597	.99437	.12331	.99237	.14061	.99006	.15787	.98746	55
6	889	604	626	434	360	233	090	002	816	741	54
7	918	602	655	431	389	230	119	.98998	845	737	53
8	947	599	684	428	418	226	148	994	873	732	52
9	976	596	713	424	447	222	177	990	902	728	51
10	.09005	.99594	.10742	.99421	.12476	.99219	.14205	.98986	.15931	.98723	50
11	034	591	771	418	504	215	234	982	959	718	49
12	063	588	800	415	533	211	263	978	988	714	48
13	092	586	829	412	562	208	292	973	.16017	709	47
14	121	583	858	409	591	204	320	969	046	704	46
15	.09150	.99580	.10887	.99406	.12620	.99200	.14349	.98965	.16074	.98700	45
16	179	578	916	402	649	197	378	961	103	695	44
17	208	575	945	399	678	193	407	957	132	690	43
18	237	572	973	396	706	189	436	953	160	686	42
19	266	570	.11002	393	735	186	464	948	189	681	41
20	.09295	.99567	.11031	.99390	.12764	.99182	.14493	.98944	.16218	.98676	40
21	324	564	060	386	793	178	522	940	246	671	39
22	353	562	089	383	822	175	551	936	275	667	38
23	382	559	118	380	851	171	580	931	304	662	37
24	411	556	147	377	880	167	608	927	333	657	36
25	.09440	.99553	.11176	.99374	.12908	.99163	.14637	.98923	.16361	.98652	35
26	469	551	205	370	937	160	666	919	390	648	34
27	498	548	234	367	966	156	695	914	419	643	33
28	527	545	263	364	995	152	723	910	447	638	32
29	556	542	291	360	.13024	148	752	906	476	633	31
30	.09585	.99540	.11320	.99357	.13053	.99144	.14781	.98902	.16505	.98629	30
31	614	537	349	354	081	141	810	897	533	624	29
32	642	534	378	351	110	137	838	893	562	619	28
33	671	531	407	347	139	133	867	889	591	614	27
34	700	528	436	344	168	129	896	884	620	609	26
35	.09729	.99526	.11465	.99341	.13197	.99125	.14925	.98880	.16648	.98604	25
36	758	523	494	337	226	122	954	876	677	600	24
37	787	520	523	334	254	118	982	871	706	595	23
38	816	517	552	331	283	114	.15011	867	734	590	22
39	845	514	580	327	312	110	040	863	763	585	21
40	.09874	.99511	.11609	.99324	.13341	.99106	.15069	.98858	.16792	.98580	20
41	903	508	638	320	370	102	097	854	820	575	19
42	932	506	667	317	399	098	126	849	849	570	18
43	961	503	696	314	427	094	155	845	878	565	17
44	990	500	725	310	456	091	184	841	906	561	16
45	.10019	.99497	.11754	.99307	.13485	.99087	.15212	.98836	.16935	.98556	15
46	048	494	783	303	514	083	241	832	964	551	14
47	077	491	812	300	543	079	270	827	992	546	13
48	106	488	840	297	572	075	299	823	.17021	541	12
49	135	485	869	293	600	071	327	818	050	536	11
50	.10164	.99482	.11898	.99290	.13629	.99067	.15356	.98814	.17078	.98531	10
51	192	479	927	286	658	063	385	809	107	526	9
52	221	476	956	283	687	059	414	805	136	521	8
53	250	473	985	279	716	055	442	800	164	516	7
54	279	470	.12014	276	744	051	471	796	193	511	6
55	.10308	.99467	.12043	.99272	.13773	.99047	.15500	.98791	.17222	.98506	5
56	337	464	071	269	802	043	529	787	250	501	4
57	366	461	100	265	831	039	557	782	279	496	3
58	395	458	129	262	860	035	586	778	308	491	2
59	424	455	158	258	889	031	615	773	336	486	1
60	.10453	.99452	.12187	.99255	.13917	.99027	.15643	.98769	.17365	.98481	0
	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	M.
	84°		83°		82°		81°		80°		

Table XIV.—NATURAL SINES AND COSINES—Continued

M.	10°		11°		12°		13°		14°		
	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	
0	0.17365	0.98481	0.19081	0.98163	0.20791	0.97815	0.22495	0.97437	0.24192	0.97030	60
1	393	476	109	157	820	809	523	430	220	023	59
2	422	471	138	152	848	803	552	424	249	015	58
3	451	466	167	146	877	797	580	417	277	008	57
4	479	461	195	140	905	791	608	411	305	001	56
5	.17508	.98455	.19224	.98135	.20933	.97784	.22637	.97404	.24333	.96994	55
6	537	450	252	129	962	778	665	398	362	987	54
7	565	445	281	124	990	772	693	391	390	980	53
8	594	440	309	118	.21019	766	722	384	418	973	52
9	623	435	338	112	047	760	750	378	446	966	51
10	.17651	.98430	.19366	.98107	.21076	.97754	.22778	.97371	.24474	.96959	50
11	680	425	395	101	104	748	807	365	503	952	49
12	708	420	423	096	132	742	835	358	531	945	48
13	737	414	452	090	161	735	863	351	559	937	47
14	766	409	481	084	189	729	892	345	587	930	46
15	.17794	.98404	.19509	.98079	.21218	.97723	.22920	.97338	.24615	.96923	45
16	823	399	538	073	246	717	948	331	644	916	44
17	852	394	566	067	275	711	977	325	672	909	43
18	880	389	595	061	303	705	.23005	318	700	902	42
19	909	383	623	056	331	698	033	311	728	894	41
20	.17937	.98378	.19652	.98050	.21360	.97692	.23062	.97304	.24756	.96887	40
21	966	373	680	044	388	686	090	298	784	880	39
22	995	368	709	039	417	680	118	291	813	873	38
23	.18023	362	737	033	445	673	146	284	841	866	37
24	052	357	766	027	474	667	175	278	869	858	36
25	.18081	.98352	.19794	.98021	.21502	.97661	.23203	.97271	.24897	.96851	35
26	109	347	823	016	530	655	231	264	925	844	34
27	138	341	851	010	559	648	260	257	954	837	33
28	166	336	880	004	587	642	288	251	982	829	32
29	195	331	908	.97998	616	636	316	244	.25010	822	31
30	.18224	.98325	.19937	.97992	.21644	.97630	.23345	.97237	.25038	.96815	30
31	252	320	965	987	672	623	373	230	066	807	29
32	281	315	994	981	701	617	401	223	094	800	28
33	309	310	.20022	975	729	611	429	217	122	793	27
34	338	304	051	969	758	604	458	210	151	786	26
35	.18367	.98299	.20079	.97963	.21786	.97598	.23486	.97203	.25179	.96778	25
36	395	294	108	958	814	592	514	196	207	771	24
37	424	288	136	952	843	585	542	189	235	764	23
38	452	283	165	946	871	579	571	182	263	756	22
39	481	277	193	940	899	573	599	176	291	749	21
40	.18509	.98272	.20222	.97934	.21928	.97566	.23627	.97169	.25320	.96742	20
41	538	267	250	928	956	560	656	162	348	734	19
42	567	261	279	922	985	553	684	155	376	727	18
43	595	256	307	916	.22013	547	712	148	404	719	17
44	624	250	336	910	041	541	740	141	432	712	16
45	.18652	.98245	.20364	.97905	.22070	.97534	.23769	.97134	.25460	.96705	15
46	681	240	393	899	098	528	797	127	488	697	14
47	710	234	421	893	126	521	825	120	516	690	13
48	738	229	450	887	155	515	853	113	545	682	12
49	767	223	478	881	183	508	882	106	573	675	11
50	.18795	.98218	.20507	.97875	.22212	.97502	.23910	.97100	.25601	.96667	10
51	824	212	535	869	240	496	938	093	629	660	9
52	852	207	563	863	268	489	966	086	657	653	8
53	881	201	592	857	297	483	995	079	685	645	7
54	910	196	620	851	325	476	.24023	072	713	638	6
55	.18938	.98190	.20649	.97845	.22353	.97470	.24051	.97065	.25741	.96630	5
56	967	185	677	839	382	463	079	058	769	623	4
57	995	179	706	833	410	457	108	051	798	615	3
58	.19024	174	734	827	438	450	136	044	826	608	2
59	052	168	763	821	467	444	164	037	854	600	1
60	.19081	.98163	.20791	.97815	.22495	.97437	.24192	.97030	.25882	.96593	0
	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	M.
	79°		78°		77°		76°		75°		

Table XIV.—NATURAL SINES AND COSINES—Continued

M.	15°		16°		17°		18°		19°		
	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	
0	0. 25882	0. 96593	0. 27564	0. 96126	0. 29237	0. 95630	0. 30902	0. 95106	0. 32557	0. 94552	60
1	910	585	592	118	265	622	929	097	584	542	59
2	938	578	620	110	293	613	957	088	612	533	58
3	966	570	648	102	321	605	985	079	639	523	57
4	994	562	676	094	348	596	.31012	070	667	514	56
5	.26022	.96555	.27704	.96086	.29376	.95588	.31040	.95061	.32694	.94504	55
6	050	547	731	078	404	579	086	052	722	495	54
7	079	540	759	070	432	571	095	043	749	485	53
8	107	532	787	062	460	562	123	033	777	476	52
9	135	524	815	054	487	554	151	024	804	466	51
10	.26163	.96517	.27843	.96046	.29515	.95545	.31178	.95015	.32832	.94457	50
11	191	509	871	037	543	536	206	006	859	447	49
12	219	502	899	029	571	528	233	.94997	887	438	48
13	247	494	927	021	599	519	261	988	914	428	47
14	275	486	955	013	626	511	289	979	942	418	46
15	.26309	.96479	.27983	.96005	.29654	.95502	.31316	.94970	.32969	.94409	45
16	331	471	.28011	.95997	682	493	344	961	997	399	44
17	359	463	039	989	710	485	372	952	.33024	390	43
18	387	456	067	981	737	476	399	943	051	380	42
19	415	448	095	972	765	467	427	933	079	370	41
20	.26443	.96440	.28123	.95964	.29793	.95459	.31454	.94924	.33106	.94361	40
21	471	433	150	956	821	450	482	915	134	351	39
22	500	425	178	948	849	441	510	906	161	342	38
23	528	417	206	940	876	433	537	897	189	332	37
24	556	410	234	931	904	424	565	888	216	322	36
25	.26584	.96402	.28262	.95923	.29932	.95415	.31593	.94878	.33244	.94313	35
26	612	394	290	915	960	407	620	869	271	303	34
27	640	386	318	907	987	398	648	860	298	293	33
28	668	379	346	898	.30015	389	675	851	326	284	32
29	696	371	374	890	043	380	703	842	353	274	31
30	.26724	.96363	.28402	.95882	.30071	.95372	.31730	.94832	.33381	.94264	30
31	752	355	429	874	098	363	758	823	408	254	29
32	780	347	457	865	126	354	786	814	436	245	28
33	808	340	485	857	154	345	813	805	463	235	27
34	836	332	513	849	182	337	841	795	490	225	26
35	.26864	.96324	.28541	.95841	.30209	.95328	.31868	.94786	.33518	.94215	25
36	892	316	569	832	237	319	896	777	545	206	24
37	920	308	597	824	265	310	923	768	573	196	23
38	948	301	625	816	292	301	951	758	600	186	22
39	976	293	652	807	320	293	979	749	627	176	21
40	.27004	.96285	.28680	.95799	.30348	.95284	.32006	.94740	.33655	.94167	20
41	032	277	708	791	376	275	034	730	682	157	19
42	060	269	736	782	403	266	061	721	710	147	18
43	088	261	764	774	431	257	089	712	737	137	17
44	116	253	792	766	459	248	116	702	764	127	16
45	.27144	.96246	.28820	.95757	.30486	.95240	.32144	.94693	.33792	.94118	15
46	172	238	847	749	514	231	171	684	819	108	14
47	200	230	875	740	542	222	199	674	846	098	13
48	228	222	903	732	570	213	227	665	874	088	12
49	256	214	931	724	597	204	254	656	901	078	11
50	.27284	.96206	.28959	.95715	.30625	.95195	.32282	.94646	.33929	.94068	10
51	312	198	987	707	653	186	309	637	956	058	9
52	340	190	.29015	698	680	177	337	627	983	049	8
53	368	182	042	690	708	168	364	618	.34011	039	7
54	396	174	070	681	736	159	392	609	038	029	6
55	.27424	.96166	.29098	.95673	.30763	.95150	.32419	.94599	.34065	.94019	5
56	452	158	126	664	791	142	447	590	093	009	4
57	480	150	154	656	819	133	474	580	120	.93999	3
58	508	142	182	647	846	124	502	571	147	989	2
59	536	134	209	639	874	115	529	561	175	979	1
60	.27564	.96126	.29237	.95630	.30902	.95106	.32557	.94552	.34202	.93969	0
	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin	Cos.	Sin.	M.
	74°		73°		72°		71°		70°		

Table XIV.—NATURAL SINES AND COSINES—Continued

M.	20°		21°		22°		23°		24°		
	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	
0	0.34202	0.93969	0.35837	0.93358	0.37461	0.92718	0.39073	0.92050	0.40674	0.91355	60
1	220	959	864	348	488	707	100	039	700	343	59
2	257	949	891	337	515	697	127	028	727	331	58
3	284	939	918	327	542	686	153	016	753	319	57
4	311	929	945	316	569	675	180	005	780	307	56
5	.34339	.93919	.35973	.93306	.37595	.92664	.39207	.91994	.40806	.91295	55
6	366	909	.36000	295	622	653	234	982	833	283	54
7	393	899	027	285	649	642	260	971	860	272	53
8	421	889	054	274	676	631	287	959	886	260	52
9	448	879	081	264	703	620	314	948	913	248	51
10	.34475	.93869	.36108	.93253	.37730	.92609	.39341	.91936	.40939	.91236	50
11	503	859	135	243	757	598	367	925	966	224	49
12	530	849	162	232	784	587	394	914	992	212	48
13	557	839	190	222	811	576	421	902	.41019	200	47
14	584	829	217	211	838	565	448	891	045	188	46
15	.34612	.93819	.36244	.93201	.37865	.92554	.39474	.91879	.41072	.91176	45
16	639	809	271	190	892	543	501	868	098	164	44
17	666	799	298	180	919	532	528	856	125	152	43
18	694	789	325	169	946	521	555	845	151	140	42
19	721	779	352	159	973	510	581	833	178	128	41
20	.34748	.93769	.36379	.93148	.37999	.92499	.39608	.91822	.41204	.91116	40
21	775	759	406	137	.38026	488	635	810	231	104	39
22	803	748	434	127	053	477	661	799	257	092	38
23	830	738	461	116	080	466	688	787	284	080	37
24	857	728	488	106	107	455	715	775	310	068	36
25	.34884	.93718	.36515	.93095	.38134	.92444	.39741	.91764	.41337	.91056	35
26	912	708	542	084	161	432	768	752	363	044	34
27	939	698	569	074	188	421	795	741	390	032	33
28	966	688	596	063	215	410	822	729	416	020	32
29	993	677	623	052	241	399	848	718	443	008	31
30	.35021	.93667	.36650	.93042	.38268	.92388	.39875	.91706	.41469	.90996	30
31	048	657	677	031	295	377	902	694	496	984	29
32	075	647	704	020	322	366	928	683	522	972	28
33	102	637	731	010	349	355	955	671	549	960	27
34	130	626	758	.92999	376	343	982	660	575	948	26
35	.35157	.93616	.36785	.92988	.38403	.92332	.40008	.91648	.41602	.90936	25
36	184	606	812	978	430	321	035	636	628	924	24
37	211	596	839	967	456	310	062	625	655	911	23
38	239	585	867	956	483	299	088	613	681	899	22
39	266	575	894	945	510	287	115	601	707	887	21
40	.35293	.93565	.36921	.92935	.38537	.92276	.40141	.91590	.41734	.90875	20
41	320	555	948	924	564	265	168	578	760	863	19
42	347	544	975	913	591	254	195	566	787	851	18
43	375	534	.37002	902	617	243	221	555	813	839	17
44	402	524	029	892	644	231	248	543	840	826	16
45	.35429	.93514	.37056	.92881	.38671	.92220	.40275	.91531	.41866	.90814	15
46	456	503	083	870	698	209	301	519	892	802	14
47	484	493	110	859	725	198	328	508	919	790	13
48	511	483	137	849	752	186	355	496	945	778	12
49	538	472	164	838	778	175	381	484	972	766	11
50	.35565	.93462	.37191	.92827	.38805	.92164	.40408	.91472	.41998	.90753	10
51	592	452	218	816	832	152	434	461	.42024	741	9
52	619	441	245	805	859	141	461	449	051	729	8
53	647	431	272	794	886	130	488	437	077	717	7
54	674	420	299	784	912	119	514	425	104	704	6
55	.35701	.93410	.37326	.92773	.38939	.92107	.40541	.91414	.42130	.90692	5
56	728	400	353	762	966	096	567	402	156	680	4
57	755	389	380	751	993	085	594	390	183	668	3
58	782	379	407	740	.39020	073	621	378	209	655	2
59	810	368	434	729	046	062	647	366	235	643	1
60	.35837	.93358	.37461	.92718	.39073	.92050	.40674	.91355	.42262	.90631	0
	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	M.
	69°		68°		67°		66°		65°		

Table XIV.—NATURAL SINES AND COSINES—Continued

M.	25°		26°		27°		28°		29°		
	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	
0	0.42262	0.90631	0.43837	0.89879	0.45399	0.89101	0.46947	0.88295	0.48481	0.87462	60
1	288	618	863	867	425	087	973	281	506	448	59
2	315	606	889	854	451	074	999	267	532	434	58
3	341	594	916	841	477	061	.47024	254	557	420	57
4	367	582	942	828	503	048	050	240	583	406	56
5	.42394	.90569	.43968	.89816	.45529	.89035	.47076	.88226	.48608	.87391	55
6	420	557	994	803	554	021	101	213	634	377	54
7	446	545	.44020	790	580	008	127	199	659	363	53
8	473	532	046	777	606	.88995	153	185	684	349	52
9	499	520	072	764	632	981	178	172	710	335	51
10	.42525	.90507	.44098	.89752	.45658	.88968	.47204	.88158	.48735	.87321	50
11	552	495	124	739	684	955	229	144	761	306	49
12	578	483	151	726	710	942	255	130	786	292	48
13	604	470	177	713	736	928	281	117	811	278	47
14	631	458	203	700	762	915	306	103	837	264	46
15	.42657	.90446	.44229	.89687	.45787	.88902	.47332	.88089	.48862	.87250	45
16	683	433	255	674	813	888	358	075	888	235	44
17	709	421	281	662	839	875	383	062	913	221	43
18	736	408	307	649	865	862	409	048	938	207	42
19	762	396	333	636	891	848	434	034	964	193	41
20	.42788	.90383	.44359	.89623	.45917	.88835	.47460	.88020	.48989	.87178	40
21	815	371	385	610	942	822	486	006	.49014	164	39
22	841	358	411	597	968	808	511	.87993	040	150	38
23	867	346	437	584	994	795	537	979	065	136	37
24	894	334	464	571	.46020	782	562	905	090	121	36
25	.42920	.90321	.44490	.89558	.46046	.88768	.47588	.87951	.49116	.87107	35
26	946	309	516	545	072	755	614	937	141	093	34
27	972	296	542	532	097	741	639	923	166	079	33
28	999	284	568	519	123	728	665	909	192	064	32
29	.43025	271	594	506	149	715	690	896	217	050	31
30	.43051	.90259	.44620	.89493	.46175	.88701	.47716	.87882	.49242	.87036	30
31	077	246	646	480	201	688	741	868	268	021	29
32	104	233	672	467	226	674	767	854	293	007	28
33	130	221	698	454	252	661	793	840	318	.86993	27
34	156	208	724	441	278	647	818	826	344	978	26
35	.43182	.90196	.44750	.89428	.46304	.88634	.47844	.87812	.49369	.86964	25
36	209	183	776	415	330	620	869	798	394	949	24
37	235	171	802	402	355	607	895	784	419	935	23
38	261	158	828	389	381	593	920	770	445	921	22
39	287	146	854	376	407	580	946	756	470	906	21
40	.43313	.90133	.44880	.89363	.46433	.88566	.47971	.87743	.49495	.86892	20
41	340	120	906	350	458	553	997	729	521	878	19
42	366	108	932	337	484	539	.48022	715	546	863	18
43	392	095	958	324	510	526	048	701	571	849	17
44	418	082	984	311	536	512	073	687	596	834	16
45	.43445	.90070	.45010	.89298	.46561	.88499	.48099	.87673	.49622	.86820	15
46	471	057	036	285	587	485	124	659	647	805	14
47	497	045	062	272	613	472	150	645	672	791	13
48	523	032	088	259	639	458	175	631	697	777	12
49	549	019	114	245	664	445	201	617	723	762	11
50	.43575	.90007	.45140	.89232	.46690	.88431	.48226	.87603	.49748	.86748	10
51	602	.89994	166	219	716	417	252	589	773	733	9
52	628	981	192	206	742	404	277	575	798	719	8
53	654	968	218	193	767	390	303	561	824	704	7
54	680	956	243	180	793	377	328	546	849	690	6
55	.43706	.89943	.45269	.89167	.46819	.88363	.48354	.87532	.49874	.86675	5
56	733	930	295	153	844	349	379	518	899	661	4
57	759	918	321	140	870	336	405	504	924	646	3
58	785	905	347	127	896	322	430	490	950	632	2
59	811	892	373	114	921	308	456	476	975	617	1
60	.43837	.89879	.45399	.89101	.46947	.88295	.48481	.87462	.50000	.86603	0
	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	M.
	64°		63°		62°		61°		60°		

Table XIV.—NATURAL SINES AND COSINES—Continued

M.	30°		31°		32°		33°		34°		
	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	
0	0.50000	0.86603	0.51504	0.85717	0.52992	0.84805	0.54404	0.83867	0.55919	0.82904	60
1	025	583	529	702	.53017	789	488	851	943	887	59
2	050	573	554	687	041	774	513	835	968	871	58
3	076	559	579	672	066	759	537	819	992	855	57
4	101	544	604	657	091	743	561	804	.56016	839	56
5	.50126	.86530	.51628	.85642	.53115	.84728	.54586	.83788	.56040	.82822	55
6	151	515	653	627	140	712	610	772	064	806	54
7	176	501	678	612	164	697	635	756	088	790	53
8	201	486	703	597	189	681	659	740	112	773	52
9	227	471	728	582	214	666	683	724	136	757	51
10	.50252	.86457	.51753	.85567	.53238	.84650	.54708	.83708	.56160	.82741	50
11	277	442	778	551	263	635	732	692	184	724	49
12	302	427	803	536	288	619	756	676	208	708	48
13	327	413	828	521	312	604	781	660	232	692	47
14	352	398	852	506	337	588	805	645	256	675	46
15	.50377	.86384	.51877	.85491	.53361	.84573	.54829	.83629	.56280	.82659	45
16	403	369	902	476	386	557	854	613	305	643	44
17	428	354	927	461	411	542	878	597	329	626	43
18	453	340	952	446	435	526	902	581	353	610	42
19	478	325	977	431	460	511	927	565	377	593	41
20	.50503	.86310	.52002	.85416	.53484	.84495	.54951	.83549	.56401	.82577	40
21	528	295	026	401	509	480	975	533	425	561	39
22	553	281	051	385	534	464	999	517	449	544	38
23	578	266	076	370	558	448	.55024	501	473	528	37
24	603	251	101	355	583	433	048	485	497	511	36
25	.50628	.86237	.52126	.85340	.53607	.84417	.55072	.83469	.56521	.82495	35
26	654	222	151	325	632	402	097	453	545	478	34
27	679	207	175	310	656	386	121	437	569	462	33
28	704	192	200	294	681	370	145	421	593	446	32
29	729	178	225	279	705	355	169	405	617	429	31
30	.50754	.86163	.52250	.85264	.53730	.84339	.55194	.83389	.56641	.82413	30
31	779	148	275	249	754	324	218	373	665	396	29
32	804	133	299	234	779	308	242	356	689	380	28
33	829	119	324	218	804	292	266	340	713	363	27
34	854	104	349	203	828	277	291	324	736	347	26
35	.50879	.86089	.52374	.85188	.53853	.84261	.55315	.83308	.56760	.82330	25
36	904	074	399	173	877	245	339	292	784	314	24
37	929	059	423	157	902	230	363	276	808	297	23
38	954	045	448	142	926	214	388	260	832	281	22
39	979	030	473	127	951	198	412	244	856	264	21
40	.51004	.86015	.52498	.85112	.53975	.84182	.55436	.83228	.56880	.82248	20
41	029	000	522	.096	.54000	167	460	212	904	231	19
42	054	.85985	547	081	024	151	484	195	928	214	18
43	079	970	572	066	049	135	509	179	952	198	17
44	104	956	597	051	073	120	533	163	976	181	16
45	.51129	.85941	.52621	.85035	.54097	.84104	.55557	.83147	.57000	.82165	15
46	154	926	646	020	122	088	581	131	024	148	14
47	179	911	671	005	146	072	605	115	047	132	13
48	204	896	696	.84989	171	057	630	098	071	115	12
49	229	881	720	974	195	041	654	082	095	098	11
50	.51254	.85866	.52745	.84959	.54220	.84025	.55678	.83066	.57119	.82082	10
51	279	851	770	943	244	009	702	050	143	065	9
52	304	836	794	928	269	.83994	726	034	167	048	8
53	329	821	819	913	293	978	750	017	191	032	7
54	354	806	844	897	317	962	775	001	215	015	6
55	.51379	.85792	.52869	.84882	.54342	.83946	.55799	.82985	.57238	.81999	5
56	404	777	893	866	366	930	823	969	262	982	4
57	429	762	918	851	391	915	847	953	286	965	3
58	454	747	943	836	415	899	871	936	310	949	2
59	479	732	967	820	440	883	895	920	334	932	1
60	.51504	.85717	.52992	.84805	.54464	.83867	.55919	.82904	.57358	.81915	0
	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	M.
	59°		58°		57°		56°		55°		

Table XIV.—NATURAL SINES AND COSINES—Continued

M.	35°		36°		37°		38°		39°		
	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	
0	0.57358	0.81915	0.58779	0.80902	0.60182	0.79864	0.61566	0.78801	0.62932	0.77715	60
1	381	899	802	885	205	846	589	783	955	696	59
2	405	882	826	867	228	829	612	765	977	678	58
3	429	865	849	850	251	811	635	747	.63000	660	57
4	453	848	873	833	274	793	658	729	022	641	56
5	.57477	.81832	.58896	.80816	.60298	.79776	.61681	.78711	.63045	.77623	55
6	501	815	920	799	321	758	704	694	068	605	54
7	524	798	943	782	344	741	726	676	090	586	53
8	548	782	967	765	367	723	749	658	113	568	52
9	572	765	990	748	390	706	772	640	135	550	51
10	.57596	.81748	.59014	.80730	.60414	.79688	.61795	.78622	.63158	.77531	50
11	619	731	037	713	437	671	818	604	180	513	49
12	643	714	061	696	460	653	841	586	203	494	48
13	667	698	084	679	483	635	864	568	225	476	47
14	691	681	108	662	506	618	887	550	248	458	46
15	.57715	.81664	.59131	.80644	.60529	.79600	.61909	.78532	.63271	.77439	45
16	738	647	154	627	553	583	932	514	293	421	44
17	762	631	178	610	576	565	955	496	316	402	43
18	786	614	201	593	599	547	978	478	338	384	42
19	810	597	225	576	622	530	.62001	460	301	366	41
20	.57833	.81580	.59248	.80558	.60645	.79512	.62024	.78442	.63383	.77347	40
21	857	563	272	541	668	494	046	424	406	329	39
22	881	546	295	524	691	477	069	405	428	310	38
23	904	530	318	507	714	459	092	387	451	292	37
24	928	513	342	489	738	441	115	369	473	273	36
25	.57952	.81496	.59365	.80472	.60761	.79424	.62138	.78351	.63496	.77255	35
26	976	479	389	455	784	406	160	333	518	236	34
27	999	462	412	438	807	388	183	315	540	218	33
28	.58023	445	436	420	830	371	206	297	563	199	32
29	047	428	459	403	853	353	229	279	585	181	31
30	.58070	.81412	.59482	.80386	.60876	.79335	.62251	.78261	.63608	.77162	30
31	094	395	506	368	899	318	274	243	630	144	29
32	118	378	529	351	922	300	297	225	653	125	28
33	141	361	552	334	945	282	320	206	675	107	27
34	165	344	576	316	968	264	342	188	698	088	26
35	.58189	.81327	.59599	.80299	.60991	.79247	.62365	.78170	.63720	.77070	25
36	212	310	622	282	.61015	229	388	152	742	051	24
37	236	293	646	264	038	211	411	134	765	033	23
38	260	276	669	247	061	193	433	116	787	014	22
39	283	259	693	230	084	176	456	098	810	.76996	21
40	.58307	.81242	.59716	.80212	.61107	.79158	.62479	.78079	.63832	.76977	20
41	330	225	739	195	130	140	502	061	854	959	19
42	354	208	763	178	153	122	524	043	877	940	18
43	378	191	786	160	176	105	547	025	899	921	17
44	401	174	809	143	199	087	570	007	922	903	16
45	.58425	.81157	.59832	.80125	.61222	.79069	.62592	.77988	.63944	.76884	15
46	449	140	856	108	245	051	615	970	966	866	14
47	472	123	879	091	268	033	638	952	989	847	13
48	496	106	902	073	291	016	660	934	.64011	828	12
49	519	089	926	056	314	.78998	683	916	033	810	11
50	.58543	.81072	.59949	.80038	.61337	.78980	.62706	.77897	.64056	.76791	10
51	567	055	972	021	360	962	728	879	078	772	9
52	590	038	995	003	383	944	751	861	100	754	8
53	614	021	.60019	.79986	406	926	774	843	123	735	7
54	637	004	042	968	429	908	796	824	145	717	6
55	.58661	.80987	.60065	.79951	.61451	.78891	.62819	.77806	.64167	.76698	5
56	684	970	089	934	474	873	842	788	190	679	4
57	708	953	112	916	497	855	864	769	212	661	3
58	731	936	135	899	520	837	887	751	234	642	2
59	755	919	158	881	543	819	909	733	256	623	1
60	.58779	.80902	.60182	.79864	.61566	.78801	.62932	.77715	.64279	.76604	0
	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	M.
	54°		53°		52°		51°		50°		

Table XIV.—NATURAL SINES AND COSINES—Concluded

M.	40°		41°		42°		43°		44°		
	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	
0	0.64279	0.76604	0.65606	0.75471	0.66913	0.74314	0.68200	0.73135	0.69466	0.71934	60
1	301	586	628	452	935	295	221	116	487	914	59
2	323	567	650	433	956	276	242	096	508	894	58
3	346	548	672	414	978	256	264	076	529	873	57
4	368	530	694	395	999	237	285	056	549	853	56
5	.64390	.76511	.65716	.75375	.67021	.74217	.68306	.73036	.69570	.71833	55
6	412	492	738	356	043	198	327	016	591	813	54
7	435	473	759	337	064	178	349	.72996	612	792	53
8	457	455	781	318	086	159	370	976	633	772	52
9	479	436	803	299	107	139	391	957	654	752	51
10	.64501	.76417	.65825	.75280	.67129	.74120	.68412	.72937	.69675	.71732	50
11	524	398	847	261	151	100	434	917	696	711	49
12	546	380	869	241	172	080	455	897	717	691	48
13	568	361	891	222	194	061	476	877	737	671	47
14	590	342	913	203	215	041	497	857	758	650	46
15	.64612	.76323	.65935	.75184	.67237	.74022	.68518	.72837	.69779	.71630	45
16	635	304	956	165	258	002	539	817	800	610	44
17	657	286	978	146	280	.73983	561	797	821	590	43
18	679	267	.66000	126	301	963	582	777	842	569	42
19	701	248	022	107	323	944	603	757	862	549	41
20	.64723	.76229	.66044	.75088	.67344	.73924	.68624	.72737	.69883	.71529	40
21	746	210	066	069	366	904	645	717	904	508	39
22	768	192	088	050	387	885	666	697	925	488	38
23	790	173	109	030	409	865	688	677	946	468	37
24	812	154	131	011	430	846	709	657	966	447	36
25	.64834	.76135	.66153	.74992	.67452	.73826	.68730	.72637	.69987	.71427	35
26	856	116	175	973	473	806	751	617	.70008	407	34
27	878	097	197	953	495	787	772	597	029	386	33
28	901	078	218	934	116	767	793	577	049	366	32
29	923	059	240	915	538	747	814	557	070	345	31
30	.64945	.76041	.66262	.74896	.67559	.73728	.68835	.72537	.70091	.71325	30
31	967	022	284	876	580	708	857	517	112	305	29
32	989	003	306	857	602	688	878	497	132	284	28
33	.65011	.75984	327	838	623	669	899	477	153	264	27
34	033	965	349	818	645	649	920	457	174	243	26
35	.65055	.75946	.66371	.74799	.67666	.73629	.68941	.72437	.70195	.71223	25
36	077	927	393	780	688	610	962	417	215	203	24
37	100	908	414	760	709	590	983	397	236	182	23
38	122	889	436	741	730	570	.69004	377	257	162	22
39	144	870	458	722	752	551	025	357	277	141	21
40	.65166	.75851	.66480	.74703	.67773	.73531	.69046	.72337	.70298	.71121	20
41	188	832	501	683	795	511	067	317	319	100	19
42	210	813	523	664	816	491	088	297	339	080	18
43	232	794	545	644	837	472	109	277	360	059	17
44	254	775	566	625	859	452	130	257	381	039	16
45	.65276	.75756	.66588	.74606	.67880	.73432	.69151	.72236	.70401	.71019	15
46	298	738	610	586	901	413	172	216	422	.70998	14
47	320	719	632	567	923	393	193	196	443	978	13
48	342	700	653	548	944	373	214	176	463	957	12
49	364	680	675	528	965	353	235	156	484	937	11
50	.65386	.75661	.66697	.74509	.67987	.73333	.69256	.72136	.70505	.70916	10
51	408	642	718	489	.68008	314	277	116	525	896	9
52	430	623	740	470	029	294	298	095	546	875	8
53	452	604	762	451	051	274	319	075	567	855	7
54	474	585	783	431	072	254	340	055	587	834	6
55	.65496	.75566	.66805	.74412	.68093	.73234	.69361	.72035	.70608	.70813	5
56	518	547	827	392	115	215	382	015	628	793	4
57	540	528	848	373	136	195	403	.71995	649	772	3
58	562	509	870	353	157	175	424	974	670	752	2
59	584	490	891	334	179	155	445	954	690	731	1
60	.65606	.75471	.66913	.74314	.68200	.73135	.69466	.71934	.70711	.70711	0
	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	M.
	49°		48°		47°		46°		45°		

Table XV.—NATURAL TANGENTS AND COTANGENTS

M.	0°		1°		2°		3°		
	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	
0	0.00000	0	0.01746	57.2900	0.03492	28.6363	0.05241	19.0811	60
1	029	3437.75	775	56.3506	521	.3994	270	18.9755	59
2	058	1718.87	804	55.4415	550	.1664	299	.8711	58
3	087	1145.92	833	54.5613	579	27.9372	328	.7678	57
4	116	859.436	862	53.7086	609	.7117	357	.6656	56
5	.00145	687.549	.01891	52.8821	.03638	27.4899	.05387	18.5645	55
6	175	572.957	920	52.0807	667	.2715	416	.4645	54
7	204	491.106	949	51.3032	696	.0566	445	.3655	53
8	233	429.718	978	50.5485	725	26.8450	474	.2677	52
9	262	381.971	.02007	49.8157	754	.6367	503	.1708	51
10	.00291	343.774	.02036	49.1039	.03783	26.4316	.05533	18.0750	50
11	320	312.521	066	48.4121	812	.2296	562	17.9802	49
12	349	286.478	095	47.7395	842	.0307	591	.8863	48
13	378	264.441	124	47.0853	871	25.8348	620	.7934	47
14	407	245.552	153	46.4489	900	.6418	649	.7015	46
15	.00436	229.182	.02182	45.8294	.03929	25.4517	.05678	17.6106	45
16	465	214.858	211	45.2261	958	.2644	708	.5205	44
17	495	202.219	240	44.6386	987	.0798	737	.4314	43
18	524	190.984	269	44.0661	.04016	24.8978	766	.3432	42
19	553	180.932	298	43.5081	046	.7185	795	.2558	41
20	.00582	171.885	.02328	42.9641	.04075	24.5418	.05824	17.1693	40
21	611	163.700	357	42.4335	104	.3675	854	.0837	39
22	640	156.259	386	41.9158	133	.1957	883	16.9990	38
23	669	149.465	415	41.4106	162	.0263	912	.9150	37
24	698	143.237	444	40.9174	191	23.8593	941	.8319	36
25	.00727	137.507	.02473	40.4358	.04220	23.6945	.05970	16.7496	35
26	756	132.219	502	39.9655	250	.5321	999	.6681	34
27	785	127.321	531	39.5059	279	.3718	.06029	.5874	33
28	815	122.774	560	39.0568	308	.2137	058	.5075	32
29	844	118.540	589	38.6177	337	.0577	087	.4283	31
30	.00873	114.589	.02619	38.1885	.04366	22.9038	.06116	16.3499	30
31	902	110.892	648	37.7686	395	.7519	145	.2722	29
32	931	107.426	677	37.3579	424	.6020	175	.1952	28
33	960	104.171	706	36.9560	454	.4541	204	.1190	27
34	989	101.107	735	36.5627	483	.3081	233	.0435	26
35	.01018	98.2179	.02764	36.1776	.04512	22.1640	.06262	15.9687	25
36	047	95.4895	793	35.8006	541	.0217	291	.8945	24
37	076	92.9085	822	35.4313	570	21.8813	321	.8211	23
38	105	90.4633	851	35.0695	599	.7426	350	.7483	22
39	135	88.1436	881	34.7151	628	.6056	379	.6762	21
40	.01164	85.9398	.02910	34.3678	.04658	21.4704	.06408	15.6048	20
41	193	83.8435	939	34.0273	687	.3369	438	.5340	19
42	222	81.8470	968	33.6935	716	.2049	467	.4638	18
43	251	79.9434	997	33.3662	745	.0747	496	.3943	17
44	280	78.1263	.03026	33.0452	774	20.9460	525	.3254	16
45	.01309	76.3900	.03055	32.7303	.04803	20.8188	.06554	15.2571	15
46	338	74.7292	084	32.4213	833	.6932	584	.1893	14
47	367	73.1390	114	32.1181	862	.5691	613	.1222	13
48	396	71.6151	143	31.8205	891	.4465	642	.0557	12
49	425	70.1533	172	31.5284	920	.3253	671	14.9898	11
50	.01455	68.7501	.03201	31.2416	.04949	20.2056	.06700	14.9244	10
51	484	67.4019	230	30.9599	978	.0872	730	.8596	9
52	513	66.1055	259	30.6833	.05007	19.9702	759	.7954	8
53	542	64.8580	288	30.4116	037	.8546	788	.7317	7
54	571	63.6567	317	30.1446	066	.7403	817	.6685	6
55	.01600	62.4992	.03346	29.8823	.05095	19.6273	.06847	14.6059	5
56	629	61.3829	376	29.6245	124	.5156	876	.5438	4
57	658	60.3058	405	29.3711	153	.4051	905	.4823	3
58	687	59.2659	434	29.1220	182	.2959	934	.4212	2
59	716	58.2612	463	28.8771	212	.1879	963	.3607	1
60	.01746	57.2900	.03492	28.6363	.05241	19.0811	.06993	14.3007	0
	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	M.
	89°		88°		87°		86°		

Table XV.—NATURAL TANGENTS AND COTANGENTS—Contd.

M.	4° Tan.	4° Cot.	5° Tan.	5° Cot.	6° Tan.	6° Cot.	7° Tan.	7° Cot.	
0	0.06993	14.3007	0.08749	11.4301	0.10510	9.51436	0.12278	8.14435	60
1	.07022	.2411	778	.3919	540	.48781	308	.12481	59
2	051	.1821	807	.3540	569	.46141	338	.10536	58
3	080	.1235	837	.3163	599	.43515	367	.08600	57
4	110	.0655	866	.2789	628	.40904	397	.06674	56
5	.07139	14.0079	.08895	11.2417	.10657	9.38307	.12426	8.04756	55
6	168	13.9507	925	.2048	687	.35724	456	.02848	54
7	197	.8940	954	.1681	716	.33155	485	.00948	53
8	227	.8378	983	.1316	746	.30599	515	7.99058	52
9	256	.7821	.09013	.0954	775	.28058	544	.97176	51
10	.07285	13.7267	.09042	11.0594	.10805	9.25530	.12574	7.95302	50
11	314	.6719	071	.0237	834	.23016	603	.93438	49
12	344	.6174	101	10.9882	863	.20516	633	.91582	48
13	373	.5634	130	.9529	893	.18028	662	.89734	47
14	402	.5098	159	.9178	922	.15554	692	.87895	46
15	.07431	13.4566	.09189	10.8829	.10952	9.13093	.12722	7.86064	45
16	461	.4039	218	.8483	981	.10646	751	.84242	44
17	490	.3515	247	.8139	.11011	.08211	781	.82428	43
18	519	.2996	277	.7797	040	.05789	810	.80622	42
19	548	.2480	306	.7457	070	.03379	840	.78825	41
20	.07578	13.1969	.09335	10.7119	.11099	9.00983	.12869	7.77035	40
21	607	.1461	365	.6783	128	8.98598	899	.75254	39
22	636	.0958	394	.6450	158	.96227	929	.73480	38
23	665	.0458	423	.6118	187	.93867	958	.71715	37
24	695	12.9962	453	.5789	217	.91520	988	.69957	36
25	.07724	12.9469	.09482	10.5462	.11246	8.89185	.13017	7.68208	35
26	753	.8981	511	.5136	276	.86862	047	.66466	34
27	782	.8496	541	.4813	305	.84551	076	.64732	33
28	812	.8014	570	.4491	335	.82252	106	.63005	32
29	841	.7536	600	.4172	364	.79964	136	.61287	31
30	.07870	12.7062	.09629	10.3854	.11394	8.77689	.13165	7.59575	30
31	899	.6591	658	.3538	423	.75425	195	.57872	29
32	929	.6124	688	.3224	452	.73172	224	.56176	28
33	958	.5660	717	.2913	482	.70931	254	.54487	27
34	987	.5199	746	.2602	511	.68701	284	.52806	26
35	.08017	12.4742	.09776	10.2294	.11541	8.66482	.13313	7.51132	25
36	046	.4288	805	.1988	570	.64275	343	.49465	24
37	075	.3838	834	.1683	600	.62078	372	.47806	23
38	104	.3390	864	.1381	629	.59893	402	.46154	22
39	134	.2946	893	.1080	659	.57718	432	.44509	21
40	.08163	12.2505	.09923	10.0780	.11688	8.55555	.13461	7.42871	20
41	192	.2067	952	.0483	718	.53402	491	.41240	19
42	221	.1632	981	.0187	747	.51259	521	.39616	18
43	251	.1201	.10011	9.98931	777	.49128	550	.37999	17
44	280	.0772	040	.96007	806	.47007	580	.36389	16
45	.08309	12.0346	.10069	9.93101	.11836	8.44896	.13609	7.34786	15
46	339	11.9923	099	.90211	865	.42795	639	.33190	14
47	368	.9504	128	.87338	895	.40705	669	.31600	13
48	397	.9087	158	.84482	924	.38625	698	.30018	12
49	427	.8673	187	.81641	954	.36555	728	.28442	11
50	.08456	11.8262	.10216	9.78817	.11983	8.34496	.13758	7.26873	10
51	485	.7853	246	.76009	.12013	.32446	787	.25310	9
52	514	.7448	275	.73217	042	.30406	817	.23754	8
53	544	.7045	305	.70441	072	.28376	846	.22204	7
54	573	.6645	334	.67680	101	.26355	876	.20661	6
55	.08602	11.6248	.10363	9.64935	.12131	8.24345	.13906	7.19125	5
56	632	.5853	393	.62205	160	.22344	935	.17594	4
57	661	.5461	422	.59490	190	.20352	965	.16071	3
58	690	.5072	452	.56791	219	.18370	995	.14553	2
59	720	.4685	481	.54106	249	.16398	.14024	.13042	1
60	.08749	11.4301	.10510	9.51436	.12278	8.14435	.14054	7.11537	0
	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	M.
	85°		84°		83°		82°		

Table XV.—NATURAL TANGENTS AND COTANGENTS—Contd.

M.	8°		9°		10°		11°		
	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	
0	0.14054	7.11537	0.15838	6.31375	0.17633	5.67128	0.19438	5.14455	60
1	084	.10038	868	.30189	663	.66165	468	.13658	59
2	113	.08546	898	.29007	693	.65205	498	.12862	58
3	143	.07059	928	.27829	723	.64248	529	.12069	57
4	173	.05579	958	.26655	753	.63295	559	.11279	56
5	.14202	7.04105	.15988	6.25486	.17783	5.62344	.19589	5.10490	55
6	232	.02637	.16017	.24321	813	.61397	619	.09704	54
7	262	.01174	047	.23160	843	.60452	649	.08921	53
8	291	6.99718	077	.22003	873	.59511	680	.08139	52
9	321	.98268	107	.20851	903	.58573	710	.07360	51
10	.14351	6.96823	.16137	6.19703	.17933	5.57638	.19740	5.06584	50
11	381	.95385	167	.18559	963	.56706	770	.05809	49
12	410	.93952	196	.17419	993	.55777	801	.05037	48
13	440	.92525	226	.16283	.18023	.54851	831	.04267	47
14	470	.91104	256	.15151	053	.53927	861	.03499	46
15	.14499	6.89688	.16286	6.14023	.18083	5.53007	.19891	5.02734	45
16	529	.88278	316	.12899	113	.52090	921	.01971	44
17	559	.86874	346	.11779	143	.51176	952	.01210	43
18	588	.85475	376	.10664	173	.50264	982	.00451	42
19	618	.84082	405	.09552	203	.49356	.20012	4.99695	41
20	.14648	6.82694	.16435	6.08444	.18233	5.48451	.20042	4.98940	40
21	678	.81312	465	.07340	263	.47548	073	.98188	39
22	707	.79936	495	.06240	293	.46648	103	.97438	38
23	737	.78564	525	.05143	323	.45751	133	.96690	37
24	767	.77199	555	.04051	353	.44857	164	.95945	36
25	.14796	6.75838	.16585	6.02962	.18384	5.43966	.20194	4.95201	35
26	826	.74483	615	.01878	414	.43077	224	.94460	34
27	856	.73133	645	.00797	444	.42192	254	.93721	33
28	886	.71789	674	5.99720	474	.41309	285	.92984	32
29	915	.70450	704	.98646	504	.40429	315	.92249	31
30	.14945	6.69116	.16734	5.97576	.18534	5.39552	.20345	4.91516	30
31	975	.67787	764	.96510	564	.38677	376	.90785	29
32	.15005	.66463	794	.95448	594	.37805	406	.90056	28
33	034	.65144	824	.94390	624	.36936	436	.89330	27
34	064	.63831	854	.93335	654	.36070	466	.88605	26
35	.15094	6.62523	.16884	5.92283	.18684	5.35206	.20497	4.87882	25
36	124	.61219	914	.91236	714	.34345	527	.87162	24
37	153	.59921	944	.90191	745	.33487	557	.86444	23
38	183	.58627	974	.89151	775	.32631	588	.85727	22
39	213	.57339	.17004	.88114	805	.31778	618	.85013	21
40	.15243	6.56055	.17033	5.87080	.18835	5.30928	.20648	4.84300	20
41	272	.54777	063	.86051	865	.30080	679	.83590	19
42	302	.53503	093	.85024	895	.29235	709	.82882	18
43	332	.52234	123	.84001	925	.28393	739	.82175	17
44	362	.50970	153	.82982	955	.27553	770	.81471	16
45	.15391	6.49710	.17183	5.81966	.18986	5.26715	.20800	4.80769	15
46	421	.48456	213	.80953	.19016	.25880	830	.80068	14
47	451	.47206	243	.79944	046	.25048	861	.79370	13
48	481	.45961	273	.78938	076	.24218	891	.78673	12
49	511	.44720	303	.77936	106	.23391	921	.77978	11
50	.15540	6.43484	.17333	5.76937	.19136	5.22566	.20952	4.77286	10
51	570	.42253	363	.75941	166	.21744	982	.76595	9
52	600	.41026	393	.74949	197	.20925	.21013	.75906	8
53	630	.39804	423	.73960	227	.20107	043	.75219	7
54	660	.38587	453	.72974	257	.19293	073	.74534	6
55	.15689	6.37374	.17483	5.71992	.19287	5.18480	.21104	4.73851	5
56	719	.36165	513	.71013	317	.17671	134	.73170	4
57	749	.34961	543	.70037	347	.16863	164	.72490	3
58	779	.33761	573	.69064	378	.16058	195	.71813	2
59	809	.32566	603	.68094	408	.15256	225	.71137	1
60	.15838	6.31375	.17633	5.67128	.19438	5.14455	.21256	4.70463	0
	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	M.
	81°		80°		79°		78°		

Table XV.—NATURAL TANGENTS AND COTANGENTS—Contd.

M.	12°		13°		14°		15°		
	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	
0	0.21256	4.70463	0.23087	4.33158	0.24933	4.01078	0.26795	3.73205	60
1	256	.69791	117	.32573	964	.00582	826	.72771	59
2	316	.69121	148	.32001	995	.00086	857	.72338	58
3	347	.68452	179	.31430	.25026	3.99592	888	.71907	57
4	377	.67786	209	.30860	056	.99099	920	.71476	56
5	.21408	4.67121	.23240	4.30291	.25087	3.98607	.26951	3.71046	55
6	438	.66458	271	.29724	118	.98117	982	.70616	54
7	469	.65797	301	.29159	149	.97627	.27013	.70188	53
8	499	.65138	332	.28595	180	.97139	044	.69761	52
9	529	.64480	363	.28032	311	.96651	076	.69335	51
10	.21560	4.65825	.23393	4.27471	.25242	3.96165	.27107	3.68909	50
11	590	.63171	424	.26911	273	.95680	138	.68485	49
12	621	.62518	455	.26352	304	.95196	169	.68061	48
13	651	.61868	485	.25795	335	.94713	201	.67638	47
14	682	.61219	516	.25239	366	.94232	232	.67217	46
15	.21712	4.60572	.23547	4.24685	.25397	3.93751	.27263	3.66796	45
16	743	.59927	578	.24132	428	.93271	294	.66376	44
17	773	.59283	608	.23580	459	.92793	326	.65957	43
18	804	.58641	639	.23030	490	.92316	357	.65538	42
19	834	.58001	670	.22481	521	.91839	388	.65121	41
20	.21864	4.57363	.23700	4.21933	.25552	3.91364	.27419	3.64705	40
21	895	.56726	731	.21387	583	.90890	451	.64289	39
22	925	.56091	762	.20842	614	.90417	482	.63874	38
23	956	.55458	793	.20298	645	.89945	513	.63461	37
24	986	.54826	823	.19756	676	.89474	545	.63048	36
25	.22017	4.54196	.23854	4.19215	.25707	3.89004	.27576	3.62636	35
26	047	.53568	885	.18675	738	.88536	607	.62224	34
27	078	.52941	916	.18137	769	.88068	638	.61814	33
28	108	.52316	946	.17600	800	.87601	670	.61405	32
29	139	.51693	977	.17064	831	.87136	701	.60996	31
30	.22169	4.51071	.24008	4.16530	.25862	3.86671	.27732	3.60588	30
31	200	.50451	039	.15997	893	.86208	764	.60181	29
32	231	.49832	069	.15465	924	.85745	795	.59775	28
33	261	.49215	100	.14934	955	.85284	826	.59370	27
34	292	.48600	131	.14405	986	.84824	858	.58966	26
35	.22322	4.47986	.24162	4.13877	.26017	3.84364	.27889	3.58562	25
36	353	.47374	193	.13350	048	.83906	921	.58160	24
37	383	.46764	223	.12825	079	.83449	952	.57758	23
38	414	.46155	254	.12301	110	.82992	983	.57357	22
39	444	.45548	285	.11778	141	.82537	.28015	.56957	21
40	.22475	4.44942	.24316	4.11256	.26172	3.82083	.28046	3.56557	20
41	505	.44338	347	.10736	203	.81630	077	.56159	19
42	536	.43735	377	.10216	235	.81177	109	.55761	18
43	567	.43134	408	.09699	266	.80726	140	.55364	17
44	597	.42534	439	.09182	297	.80276	172	.54968	16
45	.22628	4.41936	.24470	4.08666	.26328	3.79827	.28203	3.54573	15
46	658	.41340	501	.08152	359	.79378	234	.54179	14
47	689	.40745	532	.07639	390	.78931	266	.53785	13
48	719	.40152	562	.07127	421	.78485	297	.53393	12
49	750	.39560	593	.06616	452	.78040	329	.53001	11
50	.22781	4.38969	.24624	4.06107	.26483	3.77595	.28360	3.52609	10
51	811	.38381	655	.05599	515	.77152	391	.52219	9
52	842	.37793	686	.05092	546	.76709	423	.51829	8
53	872	.37207	717	.04586	577	.76268	454	.51441	7
54	903	.36623	747	.04081	608	.75828	486	.51053	6
55	.22934	4.36040	.24778	4.03578	.26639	3.75388	.28517	3.50666	5
56	964	.35459	809	.03076	670	.74950	549	.50279	4
57	995	.34879	840	.02574	701	.74512	580	.49894	3
58	.23026	.34300	871	.02074	733	.74075	612	.49509	2
59	056	.33723	902	.01576	764	.73640	643	.49125	1
60	.23087	4.33148	.24933	4.01078	.26795	3.73205	.28675	3.48741	0
	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	M.
	77°		76°		75°		74°		

Table XV.—NATURAL TANGENTS AND COTANGENTS—Contd.

M.	16°		17°		18°		19°		
	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	
0	0.28675	3.48741	0.30573	3.27085	0.32492	3.07768	0.34433	2.90421	60
1	706	.48359	605	.26745	524	.07464	465	.90147	59
2	738	.47927	637	.26406	556	.07160	498	.89873	58
3	769	.47596	669	.26067	588	.06857	530	.89600	57
4	801	.47216	700	.25729	621	.06554	563	.89327	56
5	.28832	3.46837	.30732	3.25392	.32653	3.06252	.34596	2.89055	55
6	864	.46458	764	.25055	685	.05950	628	.88783	54
7	895	.46080	796	.24719	717	.05649	691	.88511	53
8	927	.45705	828	.24383	749	.05349	603	.88240	52
9	958	.45327	860	.24049	782	.05049	726	.87970	51
10	.28990	3.44951	.30891	3.23714	.32814	3.04749	.34758	2.87700	50
11	.29021	.44576	923	.23381	846	.04450	791	.87430	49
12	053	.44202	955	.23048	878	.04152	824	.87161	48
13	084	.43829	987	.22715	911	.03854	856	.86892	47
14	116	.43456	.31019	.22384	943	.03556	889	.86624	46
15	.29147	3.43084	.31051	3.22053	.32975	3.03260	.34922	2.86356	45
16	179	.42713	083	.21722	.33007	.02963	954	.86089	44
17	210	.42343	115	.21392	040	.02667	987	.85822	43
18	242	.41973	147	.21063	072	.02372	.35020	.85555	42
19	274	.41604	178	.20734	104	.02077	052	.85289	41
20	.29305	3.41236	.31210	3.20406	.33136	3.01783	.35085	2.85023	40
21	337	.40869	242	.20079	169	.01489	118	.84758	39
22	368	.40502	274	.19752	201	.01196	150	.84494	38
23	400	.40136	300	.19426	233	.00903	183	.84229	37
24	432	.39771	338	.19100	266	.00611	216	.83965	36
25	.29463	3.39406	.31370	3.18775	.33298	3.00319	.35148	2.83702	35
26	495	.39042	402	.18451	330	.00028	281	.83439	34
27	526	.38679	434	.18127	363	2.99738	314	.83176	33
28	558	.38317	466	.17804	395	.99447	346	.82914	32
29	590	.37955	498	.17481	427	.99158	379	.82653	31
30	.29621	3.37594	.31530	3.17159	.33460	2.98868	.35412	2.82391	30
31	653	.37234	562	.16838	492	.98560	445	.82130	29
32	685	.36875	594	.16517	524	.98292	477	.81870	28
33	716	.36516	626	.16197	557	.98004	510	.81610	27
34	748	.36158	658	.15877	589	.97717	543	.81350	26
35	.29780	3.35800	.31690	3.15558	.33621	2.97430	.35576	2.81091	25
36	811	.35443	722	.15140	654	.97144	608	.80633	24
37	843	.35087	754	.14922	686	.96858	641	.80574	23
38	875	.34732	786	.14605	718	.96573	674	.80316	22
39	906	.34377	818	.14288	751	.96288	707	.80059	21
40	.29938	3.34023	.31850	3.13972	.33783	2.96004	.35740	2.79802	20
41	970	.33670	882	.13656	816	.95721	772	.79545	19
42	.30001	.33317	914	.13341	848	.95437	805	.79289	18
43	033	.32965	946	.13027	881	.95155	838	.79033	17
44	065	.32614	978	.12713	913	.94872	871	.78778	16
45	.30097	3.32264	.32010	3.12400	.33945	2.94591	.35904	2.78523	15
46	128	.31914	042	.12087	978	.94309	937	.78269	14
47	160	.31565	074	.11775	.34010	.94028	969	.78014	13
48	192	.31216	106	.11464	043	.93748	.36002	.77761	12
49	224	.30868	139	.11153	075	.93468	035	.77507	11
50	.30255	3.30521	.32171	3.10842	.34108	2.93189	.36068	2.77254	10
51	287	.30174	203	.10532	140	.92910	101	.77002	9
52	319	.29829	235	.10223	173	.92632	134	.76750	8
53	351	.29483	267	.09914	205	.92354	167	.76498	7
54	382	.29139	299	.09606	238	.92076	199	.76247	6
55	.30414	3.28795	.32331	3.09298	.34270	2.91799	.36232	2.75996	5
56	446	.28452	363	.08991	303	.91523	265	.75746	4
57	478	.28109	396	.08685	335	.91246	298	.75496	3
58	509	.27767	428	.08379	368	.90971	331	.75246	2
59	541	.27426	460	.08073	400	.90696	364	.74997	1
60	.30573	3.27085	.32492	3.07768	.34433	2.90421	.36397	2.74748	0
	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	M.
	73°		72°		71°		70°		

Table XV.—NATURAL TANGENTS AND COTANGENTS—Contd.

M.	20°		21°		22°		23°		
	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	
0	0.36397	2.74748	0.38386	2.60509	0.40403	2.47509	0.42447	2.35585	60
1	430	.74499	420	.60283	436	.47302	482	.35395	59
2	364	.74251	453	.60057	470	.47095	516	.35205	58
3	496	.74004	487	.59831	504	.46888	551	.35015	57
4	529	.73756	520	.59606	538	.46682	585	.34825	56
5	.36562	2.73509	.38553	2.59381	.40572	2.46476	.42619	2.34636	55
6	595	.73263	587	.59156	606	.46270	654	.34447	54
7	628	.73017	620	.58932	640	.46065	688	.34258	53
8	661	.72771	654	.58708	674	.45860	722	.34069	52
9	694	.72526	687	.58484	707	.45655	757	.33881	51
10	.36727	2.72281	.38721	2.58261	.40741	2.45451	.42791	2.33693	50
11	760	.72036	754	.58038	775	.45246	826	.33505	49
12	793	.71792	787	.57815	809	.45043	860	.33317	48
13	826	.71548	821	.57593	843	.44839	894	.33130	47
14	859	.71305	854	.57371	877	.44636	929	.32943	46
15	.36892	2.71062	.38888	2.57150	.40911	2.44433	.42963	2.32756	45
16	925	.70819	921	.56928	945	.44230	998	.32570	44
17	958	.70577	955	.56707	979	.44027	.43032	.32383	43
18	991	.70335	988	.56487	.41013	.43825	067	.32197	42
19	.37024	.70094	.39022	.56266	047	.43623	101	.32012	41
20	.37057	2.69853	.39055	2.56046	.41081	2.43422	.43136	2.31826	40
21	090	.69612	089	.55827	115	.43220	170	.31641	39
22	123	.69371	122	.55608	149	.43019	205	.31456	38
23	157	.69131	156	.55389	183	.42819	239	.31271	37
24	190	.68892	190	.55170	217	.42618	274	.31086	36
25	.37223	2.68653	.39223	2.54952	.41251	2.42418	.43308	2.30902	35
26	256	.68414	257	.54734	285	.42218	343	.30718	34
27	289	.68175	290	.54516	319	.42019	378	.30534	33
28	322	.67937	324	.54299	353	.41819	412	.30351	32
29	355	.67700	357	.54082	387	.41620	447	.30167	31
30	.37388	2.67462	.39391	2.53865	.41421	2.41421	.43481	2.29984	30
31	422	.67225	425	.53648	455	.41223	516	.29801	29
32	455	.66989	458	.53432	490	.41025	550	.29619	28
33	488	.66752	492	.53217	524	.40827	585	.29437	27
34	521	.66516	526	.53001	558	.40629	620	.29254	26
35	.37554	2.66281	.39559	2.52786	.41592	2.40432	.43654	2.29073	25
36	588	.66046	593	.52571	626	.40235	689	.28891	24
37	621	.65811	626	.52357	660	.40038	724	.28710	23
38	654	.65576	660	.52142	694	.39841	758	.28528	22
39	687	.65342	694	.51929	728	.39645	793	.28348	21
40	.37720	2.65109	.39727	2.51715	.41763	2.39449	.43828	2.28167	20
41	754	.64875	761	.51502	797	.39253	862	.27987	19
42	787	.64642	795	.51289	831	.39058	897	.27806	18
43	820	.64410	829	.51076	865	.38863	932	.27626	17
44	853	.64177	862	.50864	899	.38668	966	.27447	16
45	.37887	2.63945	.39896	2.50652	.41933	2.38473	.44001	2.27267	15
46	920	.63714	930	.50440	968	.38279	036	.27088	14
47	953	.63483	963	.50229	.42002	.38084	071	.26909	13
48	986	.63252	997	.50018	036	.37891	105	.26730	12
49	.38020	.63021	.40031	.49807	070	.37697	140	.26552	11
50	.38053	2.62791	.40065	2.49597	.42105	2.37594	.44175	2.26374	10
51	086	.62561	098	.49386	139	.37311	210	.26196	9
52	120	.62332	132	.49177	173	.37118	244	.26018	8
53	153	.62103	166	.48967	207	.36925	279	.25840	7
54	186	.61874	200	.48758	242	.36733	314	.25663	6
55	.38220	2.61646	.40234	2.48549	.42276	2.36541	.44349	2.25486	5
56	253	.61418	267	.48340	310	.36349	384	.25309	4
57	286	.61190	301	.48132	345	.36158	418	.25132	3
58	320	.60963	335	.47924	379	.35967	453	.24956	2
59	353	.60736	369	.47716	413	.35776	488	.24780	1
60	.38386	2.60509	.40403	2.47509	.42447	2.35585	.44523	2.24604	0
	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	M.
	69°		68°		67°		66°		

Table XV.—NATURAL TANGENTS AND COTANGENTS—Contd.

M.	24°		25°		26°		27°		
	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	
0	0.44523	2.24604	0.46631	2.14451	0.48773	2.05030	0.50953	1.96261	60
1	558	.24428	666	.14288	809	.04879	989	.96120	59
2	593	.24252	702	.14125	845	.04728	.51026	.95979	58
3	627	.24077	737	.13963	881	.04577	063	.95838	57
4	662	.23902	772	.13801	917	.04426	099	.95698	56
5	.44697	2.23727	.46808	2.13639	.48953	2.04276	.51136	1.95557	55
6	732	.23553	843	.13477	989	.04125	173	.95417	54
7	767	.23378	879	.13316	.49026	.03975	209	.95277	53
8	802	.23204	914	.13154	062	.03825	246	.95137	52
9	837	.23030	950	.12993	098	.03675	283	.94997	51
10	.44872	2.22857	.46985	2.12832	.49134	2.03526	.51319	1.94858	50
11	907	.22683	.47021	.12671	170	.03376	356	.94718	49
12	942	.22510	056	.12511	206	.03227	393	.94579	48
13	977	.22337	092	.12350	242	.03078	430	.94440	47
14	.45012	.22164	128	.12190	278	.02929	467	.94301	46
15	.45047	2.21992	.47163	2.12030	.49315	2.02780	.51503	1.94162	45
16	982	.21819	199	.11871	351	.02631	540	.94023	44
17	117	.21647	234	.11711	387	.02483	577	.93885	43
18	152	.21475	270	.11552	423	.02335	614	.93746	42
19	187	.21304	305	.11392	459	.02187	651	.93608	41
20	.45222	2.21132	.47341	2.11233	.49495	2.02039	.51688	1.93470	40
21	257	.20961	377	.11075	532	.01891	724	.93332	39
22	292	.20790	412	.10916	568	.01743	761	.93195	38
23	327	.20619	448	.10758	604	.01596	798	.93057	37
24	362	.20449	483	.10600	640	.01449	835	.92920	36
25	.45397	2.20278	.47519	2.10442	.49677	2.01302	.51872	1.92782	35
26	432	.20108	555	.10284	713	.01155	909	.92645	34
27	467	.19938	590	.10126	749	.01008	946	.92508	33
28	502	.19769	626	.09969	786	.00862	983	.92371	32
29	538	.19599	662	.09811	822	.00715	.52020	.92235	31
30	.45573	2.19430	.47698	2.09654	.49858	2.00569	.52057	1.92098	30
31	608	.19261	733	.09498	894	.00423	094	.91962	29
32	643	.19092	769	.09341	931	.00277	131	.91826	28
33	678	.18923	805	.09184	967	.00131	168	.91690	27
34	713	.18755	840	.09028	.50004	1.99986	205	.91554	26
35	.45748	2.18587	.47876	2.08872	.50040	1.99841	.52242	1.91418	25
36	784	.18419	912	.08716	076	.99695	279	.91282	24
37	819	.18251	948	.08560	113	.99550	316	.91147	23
38	854	.18084	984	.08405	149	.99406	353	.91012	22
39	889	.17916	.48019	.08250	185	.99261	390	.90876	21
40	.45924	2.17749	.48055	2.08094	.50222	1.99116	.52427	1.90741	20
41	960	.17582	091	.07939	258	.98972	464	.90607	19
42	995	.17416	127	.07785	295	.98828	501	.90472	18
43	.46030	.17249	163	.07630	331	.98684	538	.90337	17
44	065	.17083	198	.07476	368	.98540	575	.90203	16
45	.46101	2.16917	.48234	2.07321	.50404	1.98396	.52613	1.90069	15
46	136	.16751	270	.07167	441	.98253	650	.89935	14
47	171	.16585	306	.07014	477	.98110	687	.89801	13
48	206	.16420	342	.06860	514	.97966	724	.89667	12
49	242	.16255	378	.06706	550	.97823	761	.89533	11
50	.46277	2.16090	.48414	2.06553	.50587	1.97681	.52798	1.89400	10
51	312	.15925	450	.06400	623	.97538	836	.89266	9
52	348	.15760	486	.06247	660	.97395	873	.89133	8
53	383	.15596	521	.06094	696	.97253	910	.89000	7
54	418	.15432	557	.05942	733	.97111	947	.88867	6
55	.46454	2.15268	.48593	2.05790	.50769	1.96969	.52985	1.88734	5
56	489	.15104	629	.05637	806	.96827	.53022	.88602	4
57	525	.14940	665	.05485	843	.96685	059	.88469	3
58	560	.14777	701	.05333	879	.96544	096	.88337	2
59	595	.14614	737	.05182	916	.96402	134	.88205	1
60	.46631	2.14451	.48773	2.05030	.50953	1.96261	.53171	1.88073	0
	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	M.
	65°		64°		63°		62°		

Table XV.—NATURAL TANGENTS AND COTANGENTS—Contd.

M.	28°		29°		30°		31°		
	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	
0	0.53171	1.88073	0.55431	1.80405	0.57735	1.73205	0.60086	1.66428	60
1	208	.87941	469	.80281	774	.73089	126	.66318	59
2	246	.87809	507	.80158	813	.72973	165	.66209	58
3	283	.87677	545	.80034	851	.72857	205	.66099	57
4	320	.87546	583	.79911	890	.72741	245	.65990	57
5	.53358	1.87415	.55621	1.79788	.57929	1.72625	.60284	1.65881	55
6	395	.87283	659	.79665	968	.72509	324	.65772	54
7	432	.87152	697	.79542	.58007	.72393	364	.65663	53
8	470	.87021	736	.79419	046	.72278	403	.65554	52
9	507	.86891	774	.79296	085	.72163	443	.65445	51
10	.53545	1.86760	.55812	1.79174	.58124	1.72047	.60483	1.65337	50
11	582	.86630	850	.79051	162	.71932	522	.65228	49
12	620	.86499	888	.78929	201	.71817	562	.65120	48
13	657	.86369	926	.78807	240	.71702	602	.65011	47
14	694	.86239	964	.78685	279	.71588	642	.64903	46
15	.53732	1.86109	.56003	1.78563	.58318	1.71473	.60681	1.64795	45
16	769	.85979	041	.78441	357	.71358	721	.64687	44
17	807	.85850	079	.78319	396	.71244	761	.64579	43
18	844	.85720	117	.78198	435	.71129	801	.64471	42
19	882	.85591	156	.78077	474	.71015	841	.64363	41
20	.53920	1.85462	.56194	1.77955	.58513	1.70901	.60881	1.64256	40
21	957	.85333	232	.77834	552	.70787	921	.64148	39
22	995	.85204	270	.77713	591	.70673	960	.64041	38
23	.54032	.85075	309	.77592	631	.70560	.61000	.63934	37
24	070	.84946	347	.77471	670	.70446	040	.63826	36
25	.54107	1.84818	.56385	1.77351	.58709	1.70332	.61080	1.63719	35
26	145	.84689	424	.77230	748	.70219	120	.63612	34
27	183	.84561	462	.77110	787	.70106	160	.63505	33
28	220	.84433	501	.76990	826	.69992	200	.63398	32
29	258	.84305	539	.76869	865	.69879	240	.63292	31
30	.54296	1.84177	.56577	1.76749	.58905	1.69766	.61280	1.63185	30
31	333	.84049	616	.76629	944	.69653	320	.63079	29
32	371	.83922	654	.76510	983	.69541	360	.62972	28
33	409	.83794	693	.76390	.59022	.69428	400	.62866	27
34	446	.83667	731	.76271	061	.69316	440	.62760	26
35	.54484	1.83540	.56769	1.76151	.59101	1.69203	.61480	1.62654	25
36	522	.83413	808	.76032	140	.69091	520	.62548	24
37	560	.83286	846	.75913	179	.68979	561	.62442	23
38	597	.83159	885	.75794	218	.68866	601	.62336	22
39	635	.83033	923	.75675	258	.68754	641	.62230	21
40	.54673	1.82906	.56962	1.75556	.59297	1.68643	.61681	1.62125	20
41	711	.82780	.57000	.75437	336	.68531	721	.62019	19
42	748	.82654	039	.75319	376	.68419	761	.61914	18
43	786	.82528	078	.75200	415	.68308	801	.61808	17
44	824	.82402	116	.75082	454	.68196	842	.61703	16
45	.54862	1.82276	.57155	1.74964	.59494	1.68085	.61882	1.61598	15
46	900	.82150	193	.74846	533	.67974	922	.61493	14
47	938	.82025	232	.74728	573	.67863	962	.61388	13
48	975	.81899	271	.74610	612	.67752	.62003	.61283	12
49	.55013	.81774	309	.74492	651	.67641	043	.61179	11
50	.55051	1.81649	.57348	1.74375	.59691	1.67530	.62083	1.61074	10
51	089	.81524	386	.74257	730	.67419	124	.60970	9
52	127	.81399	425	.74140	770	.67309	164	.60865	8
53	165	.81274	464	.74022	809	.67198	204	.60761	7
54	203	.81150	503	.73905	849	.67088	245	.60657	6
55	.55241	1.81025	.57541	1.73788	.59888	1.66978	.62285	1.60553	5
56	279	.80901	580	.73671	928	.66867	325	.60449	4
57	317	.80777	619	.73555	967	.66757	366	.60345	3
58	355	.80653	657	.73438	.60007	.66647	406	.60241	2
59	393	.80529	696	.73321	046	.66538	446	.60137	1
60	.55431	1.80405	.57735	1.73205	.60086	1.66428	.62487	1.60033	0
	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	M.
	61°		60°		59°		58°		

Table XV.—NATURAL TANGENTS AND COTANGENTS—Contd.

M.	32°		33°		34°		35°		
	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	
0	0.62487	1.60033	0.64941	1.53986	0.67451	1.48256	0.70021	1.42815	60
1	527	.59930	982	.53888	493	.48163	064	.42726	59
2	568	.59826	.65024	.53791	536	.48070	107	.42638	58
3	608	.59723	065	.53693	578	.47977	151	.42550	57
4	649	.59620	106	.53595	620	.47885	194	.42462	56
5	.62689	1.59517	.65148	1.53497	.67663	1.47792	.70238	1.42374	55
6	730	.59414	189	.53400	705	.47699	281	.42286	54
7	770	.59311	231	.53302	748	.47607	325	.42198	53
8	811	.59208	272	.53205	790	.47514	368	.42110	52
9	852	.59105	314	.53107	832	.47422	412	.42022	51
10	.62892	1.59002	.65355	1.53010	.67875	1.47330	.70455	1.41934	50
11	933	.58900	397	.52913	917	.47238	499	.41847	49
12	973	.58797	438	.52816	960	.47146	542	.41759	48
13	.63014	.58695	480	.52719	.68002	.47053	586	.41672	47
14	055	.58593	521	.52622	045	.46962	629	.41584	46
15	.63095	1.58490	.65563	1.52525	.68088	1.46870	.70673	1.41497	45
16	136	.58388	604	.52429	130	.46778	717	.41409	44
17	177	.58286	646	.52332	173	.46686	760	.41322	43
18	217	.58184	688	.52235	215	.46595	804	.41235	42
19	258	.58083	729	.52139	258	.46503	848	.41148	41
20	.63299	1.57981	.65771	1.52043	.68301	1.46411	.70891	1.41061	40
21	340	.57879	813	.51946	343	.46320	935	.40974	39
22	380	.57778	854	.51850	386	.46229	979	.40887	38
23	421	.57676	896	.51754	429	.46137	.71023	.40800	37
24	462	.57575	938	.51658	471	.46046	066	.40714	36
25	.63503	1.57474	.65980	1.51562	.68514	1.45955	.71110	1.40627	35
26	544	.57372	.66021	.51466	557	.45864	154	.40540	34
27	584	.57271	063	.51370	600	.45773	198	.40454	33
28	625	.57170	105	.51275	642	.45682	242	.40367	32
29	666	.57069	147	.51179	685	.45592	285	.40281	31
30	.63707	1.56969	.66189	1.51084	.68728	1.45501	.71329	1.40195	30
31	748	.56868	230	.50988	771	.45410	373	.40109	29
32	789	.56767	272	.50893	814	.45320	417	.40022	28
33	830	.56667	314	.50797	857	.45229	461	.39936	27
34	871	.56566	356	.50702	900	.45139	505	.39850	26
35	.63912	1.56466	.66398	1.50607	.68942	1.45049	.71549	1.39764	25
36	953	.56366	440	.50512	985	.44958	593	.39679	24
37	994	.56265	482	.50417	.69028	.44868	637	.39593	23
38	.64035	.56165	524	.50322	071	.44778	681	.39507	22
39	076	.56065	566	.50228	114	.44688	725	.39421	21
40	.64117	1.55966	.66608	1.50133	.69157	1.44598	.71769	1.39336	20
41	158	.55866	650	.50038	200	.44508	813	.39250	19
42	199	.55766	692	.49944	243	.44418	857	.39165	18
43	240	.55666	734	.49849	286	.44329	901	.39079	17
44	281	.55567	776	.49755	329	.44239	946	.38994	16
45	.64322	1.55467	.66818	1.49661	.69372	1.44149	.71990	1.38909	15
46	363	.55368	860	.49566	416	.44060	.72034	.38824	14
47	404	.55269	902	.49472	459	.43970	078	.38738	13
48	446	.55170	944	.49378	502	.43881	122	.38653	12
49	487	.55071	986	.49284	545	.43792	167	.38568	11
50	.64528	1.54972	.67028	1.49190	.69588	1.43703	.72211	1.38484	10
51	569	.54873	071	.49097	631	.43614	255	.38399	9
52	610	.54774	113	.49003	675	.43525	299	.38314	8
53	652	.54675	155	.48909	718	.43436	344	.38229	7
54	693	.54576	197	.48816	761	.43347	388	.38145	6
55	.64734	1.54478	.67239	1.48722	.69804	1.43258	.72432	1.38060	5
56	775	.54379	282	.48629	847	.43169	477	.37976	4
57	817	.54281	324	.48536	891	.43080	521	.37891	3
58	858	.54183	366	.48442	934	.42992	565	.37807	2
59	899	.54085	409	.48349	977	.42903	610	.37722	1
60	.64941	1.53986	.67451	1.48256	.70021	1.42815	.72654	1.37638	0
	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	M.
	57°		56°		55°		54°		

Table XV.—NATURAL TANGENTS AND COTANGENTS—Contd.

M.	36°		37°		38°		39°		
	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	
0	0.72654	1.37638	0.75355	1.32704	0.78129	1.2794	0.80978	1.23490	60
1	699	.37554	401	.32624	175	.27917	.81027	.23416	59
2	743	.37470	447	.32544	222	.27841	075	.23343	58
3	788	.37386	492	.32464	269	.27764	123	.23270	57
4	832	.37302	538	.32384	316	.27688	171	.23196	56
5	.72877	1.37218	.75584	1.32304	.78363	1.27611	.81220	1.23123	55
6	921	.37134	629	.32224	410	.27535	268	.23050	54
7	966	.37050	675	.32144	457	.27458	316	.22977	53
8	.73010	.36967	721	.32064	504	.27382	364	.22904	52
9	055	.36883	767	.31984	551	.27306	413	.22831	51
10	.73100	1.36800	.75812	1.31904	.78598	1.27230	.81461	1.22758	50
11	144	.36716	858	.31825	645	.27153	510	.22685	49
12	189	.36633	904	.31745	692	.27077	558	.22612	48
13	234	.36549	950	.31666	739	.27001	606	.22539	47
14	278	.36466	996	.31586	786	.26925	655	.22467	46
15	.73323	1.36383	.76042	1.31507	.78834	1.26849	.81703	1.22394	45
16	368	.36300	088	.31427	881	.26774	752	.22321	44
17	413	.36217	134	.31348	928	.26698	800	.22249	43
18	457	.36134	180	.31269	975	.26622	849	.22176	42
19	502	.36051	226	.31190	.79022	.26546	898	.22104	41
20	.73547	1.35968	.76272	1.31110	.79070	1.26471	.81946	1.22031	40
21	592	.35885	318	.31031	117	.26395	995	.21959	39
22	637	.35802	364	.30952	164	.26319	.82044	.21886	38
23	681	.35719	410	.30873	212	.26244	092	.21814	37
24	726	.35637	456	.30795	259	.26169	141	.21742	36
25	.73771	1.3554	.76502	1.30716	.79306	1.26093	.82190	1.21670	35
26	816	.35472	548	.30637	354	.26018	238	.21598	34
27	861	.35389	594	.30558	401	.25943	287	.21526	33
28	906	.35307	640	.30480	449	.25867	336	.21454	32
29	951	.35224	686	.30401	496	.25792	385	.21382	31
30	.73996	1.35142	.76733	1.30323	.79544	1.25717	.82434	1.21310	30
31	.74041	.35060	779	.30244	591	.25642	483	.21238	29
32	086	.34978	825	.30166	639	.25567	531	.21166	28
33	131	.34896	871	.30087	686	.25492	580	.21094	27
34	176	.34814	918	.30009	734	.25417	629	.21023	26
35	.74221	1.34732	.76964	1.29931	.79781	1.25343	.82678	1.20951	25
36	267	.34650	.77010	.29853	829	.25268	727	.20879	24
37	312	.34568	057	.29775	877	.25193	776	.20808	23
38	357	.34487	103	.29696	924	.25118	825	.20736	22
39	402	.34405	149	.29618	972	.25044	874	.20665	21
40	.74447	1.34323	.77196	1.29541	.80020	1.24969	.82923	1.20593	20
41	492	.34242	242	.29463	067	.24895	972	.20522	19
42	538	.34160	289	.29385	115	.24820	.83022	.20451	18
43	583	.34079	335	.29307	163	.24746	071	.20379	17
44	628	.33998	382	.29229	211	.24672	120	.20308	16
45	.74674	1.33916	.77428	1.29152	.80258	1.24597	.83169	1.20237	15
46	719	.33835	475	.29074	306	.24523	218	.20166	14
47	764	.33754	521	.28997	354	.24449	268	.20095	13
48	810	.33673	568	.28919	402	.24375	317	.20024	12
49	855	.33592	615	.28842	450	.24301	366	.19953	11
50	.74900	1.33511	.77661	1.28764	.80498	1.24227	.83415	1.19882	10
51	946	.33430	708	.28687	546	.24153	465	.19811	9
52	991	.33349	754	.28610	594	.24079	514	.19740	8
53	.75037	.33268	801	.28533	642	.24005	564	.19669	7
54	082	.33187	848	.28456	690	.23931	613	.19599	6
55	.75128	1.33107	.77895	1.28379	.80738	1.23858	.83662	1.19528	5
56	173	.33026	941	.28302	786	.23784	712	.19457	4
57	219	.32946	988	.28225	834	.23710	761	.19387	3
58	264	.32865	.78035	.28148	882	.23637	811	.19316	2
59	310	.32785	082	.28071	930	.23563	860	.19246	1
60	.75355	1.32704	.78129	1.27994	.80978	1.23490	.83910	1.19175	0
	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	M.
	53°		52°		51°		50°		

Table XV.—NATURAL TANGENTS AND COTANGENTS—Contd.

M.	40°		41°		42°		43°		
	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	
0	0.83910	1.19175	0.86929	1.15037	0.90040	1.11061	0.93252	1.07237	60
1	960	.19105	980	.14969	093	.10996	306	.07174	59
2	.84009	.19035	.87031	.14902	146	.10931	360	.07112	58
3	059	.18964	082	.14834	199	.10867	415	.07049	57
4	108	.18894	133	.14767	251	.10802	469	.06987	56
5	.84158	1.18824	.87184	1.14699	.90304	1.10737	.93524	1.06925	55
6	208	.18754	236	.14632	357	.10672	578	.06862	54
7	258	.18684	287	.14565	410	.10607	633	.06800	53
8	307	.18614	338	.14498	463	.10543	688	.06738	52
9	357	.18544	389	.14430	516	.10478	742	.06676	51
10	.84407	1.18474	.87441	1.14363	.90569	1.10414	.93797	1.06613	50
11	457	.18404	492	.14296	621	.10349	852	.06551	49
12	507	.18334	543	.14229	674	.10285	906	.06489	48
13	556	.18264	595	.14162	727	.10220	961	.06427	47
14	606	.18194	646	.14095	781	.10156	.94016	.06365	46
15	.84656	1.18125	.87698	1.14028	.90834	1.10091	.94071	1.06303	45
16	706	.18055	749	.13961	887	.10027	125	.06241	44
17	756	.17986	801	.13894	940	.09963	180	.06179	43
18	806	.17916	852	.13828	993	.09899	235	.06117	42
19	856	.17846	904	.13761	.91046	.09834	290	.06056	41
20	.84906	1.17777	.87955	1.13694	.91099	1.09770	.94345	1.05994	40
21	956	.17708	.88007	.13627	153	.09706	400	.05932	39
22	.85006	.17638	059	.13561	206	.09642	455	.05870	38
23	057	.17569	110	.13494	259	.09578	510	.05809	37
24	107	.17500	162	.13428	313	.09514	565	.05747	36
25	.85157	1.17430	.88214	1.13361	.91366	1.09450	.94620	1.05685	35
26	207	.17361	265	.13295	419	.09386	676	.05624	34
27	257	.17292	317	.13228	473	.09322	731	.05562	33
28	308	.17223	369	.13162	526	.09258	786	.05501	32
29	358	.17154	421	.13096	580	.09195	841	.05439	31
30	.85408	1.17085	.88473	1.13029	.91633	1.09131	.94896	1.05378	30
31	458	.17016	524	.12963	687	.09067	952	.05317	29
32	509	.16947	576	.12897	740	.09003	.95007	.05255	28
33	559	.16878	628	.12831	794	.08940	062	.05194	27
34	609	.16809	680	.12765	847	.08876	118	.05133	26
35	.85660	1.16741	.88732	1.12699	.91901	1.08813	.95173	1.05072	25
36	710	.16672	784	.12633	955	.08749	229	.05010	24
37	761	.16603	836	.12567	.92008	.08686	284	.04949	23
38	811	.16535	888	.12501	062	.08622	340	.04888	22
39	862	.16466	940	.12435	116	.08559	395	.04827	21
40	.85912	1.16398	.88992	1.12369	.92170	1.08496	.95451	1.04766	20
41	963	.16329	.89045	.12303	224	.08432	506	.04705	19
42	.86014	.16261	097	.12238	277	.08369	562	.04644	18
43	064	.16192	149	.12172	331	.08306	618	.04583	17
44	115	.16124	201	.12105	385	.08243	673	.04522	16
45	.86166	1.16056	.89253	1.12041	.92439	1.08179	.95729	1.04461	15
46	216	.15987	306	.11975	493	.08116	785	.04401	14
47	267	.15919	358	.11909	547	.08053	841	.04340	13
48	318	.15851	410	.11844	601	.07990	897	.04279	12
49	368	.15783	463	.11778	655	.07927	952	.04218	11
50	.86419	1.15715	.89515	1.11713	.92709	1.07864	.96008	1.04158	10
51	470	.15647	567	.11648	763	.07801	064	.04097	9
52	521	.15579	620	.11582	817	.07738	120	.04036	8
53	572	.15511	672	.11517	872	.07676	176	.03976	7
54	623	.15443	725	.11452	926	.07613	232	.03915	6
55	.86674	1.15375	.89777	1.11387	.92980	1.07550	.96288	1.03855	5
56	725	.15308	830	.11321	.93034	.07487	344	.03794	4
57	776	.15240	883	.11256	088	.07425	400	.03734	3
58	827	.15172	935	.11191	143	.07362	457	.03674	2
59	878	.15104	988	.11126	197	.07299	513	.03613	1
60	.86929	1.15037	.90040	1.11061	.93252	1.07237	.96569	1.03553	0
	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	Cot.	Tan.	M.
	49°		48°		47°		46°		

Table XV.—NATURAL TANGENTS AND COTANGENTS—Contd.

M.	44° Tan.	44° Cot.		M.	44° Tan.	44° Cot.		M.	44° Tan.	44° Cot.	
0	0.96569	1.03553	60	20	0.97700	1,02355	40	40	0.98843	1.01170	20
1	625	.03493	59	21	756	.02295	39	41	901	.01112	19
2	681	.03433	58	22	813	.02236	38	42	958	.01053	18
3	738	.03372	57	23	870	.02176	37	43	.99016	.00994	17
4	794	.03312	56	24	927	.02117	36	44	073	.00935	16
5	.96850	1.03252	55	25	.97984	1.02057	35	45	.99131	1.00876	15
6	907	.03192	54	26	.98041	.01998	34	46	189	.00818	14
7	963	.03132	53	27	098	.01939	33	47	247	.00759	13
8	.97020	.03072	52	28	155	.01879	32	48	304	.00701	12
9	076	.03012	51	29	213	.01820	31	49	362	.00642	11
10	.97133	1.02952	50	30	.98270	1.01761	30	50	.99420	1.00583	10
11	189	.02892	49	31	327	.01702	29	51	478	.00525	9
12	246	.02832	48	32	384	.01642	28	52	536	.00467	8
13	302	.02772	47	33	441	.01583	27	53	594	.00408	7
14	359	.02713	46	34	499	.01524	26	54	652	.00350	6
15	.97416	1.02653	45	35	.98556	1.01465	25	55	.99710	1.00291	5
16	472	.02593	44	36	613	.01406	24	56	768	.00233	4
17	529	.02533	43	37	671	.01347	23	57	826	.00175	3
18	586	.02474	42	38	728	.01288	22	58	884	.00116	2
19	643	.02414	41	39	786	.01229	21	59	942	.00058	1
20	.97700	1.02355	40	40	.98843	1.01170	20	60	1.00000	1.00000	0
	Cot.	Tan.	M.		Cot.	Tan.	M.		Cot.	Tan.	M.
	45°				45°				45°		

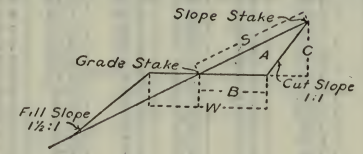
Table XVI.—SLOPE STAKES AND AREAS

[For use on Forest Service minor roads]

CUT SLOPE 1:1

Slope, %	Width of finished road															
	9				10				11				12			
	B	C	S	A	B	C	S	A	B	C	S	A	B	C	S	A
10	4.8	0.5	5.4	1.3	5.3	0.6	5.9	1.6	5.9	0.7	6.6	1.6	6.5	0.7	7.2	2.2
12	4.8	0.7	5.5	1.6	5.3	0.7	6.1	2.0	5.9	0.8	6.8	2.4	6.4	0.9	7.4	2.8
14	4.8	0.8	5.7	1.9	5.3	0.9	6.3	2.4	5.9	1.0	7.0	2.9	6.4	1.1	7.6	3.4
16	4.9	0.9	5.8	2.2	5.4	1.0	6.4	2.8	6.0	1.2	7.2	3.4	6.5	1.2	7.8	4.9
18	4.9	1.1	6.0	2.5	5.4	1.2	6.6	3.2	6.0	1.3	7.4	3.9	6.5	1.4	8.0	4.6
20	4.9	1.2	6.2	2.9	5.4	1.4	6.8	3.6	6.0	1.5	7.6	4.5	6.5	1.6	8.3	5.2
22	4.9	1.4	6.4	3.4	5.4	1.5	7.2	4.1	6.0	1.7	7.9	5.1	6.5	1.9	8.6	6.0
24	4.9	1.6	6.7	3.9	5.4	1.7	7.4	4.7	6.0	1.9	8.2	5.8	6.6	2.1	8.9	6.9
26	5.0	1.7	6.9	4.4	5.5	1.9	7.6	5.3	6.1	2.1	8.5	6.5	6.6	2.3	9.2	7.8
28	5.0	1.9	7.2	4.9	5.5	2.1	7.9	5.9	6.1	2.4	8.8	7.2	6.7	2.6	9.6	8.7
30	5.0	2.1	7.5	5.4	5.5	2.4	8.2	6.5	6.1	2.6	9.1	7.9	6.7	2.9	10.0	9.6
32	5.0	2.4	7.8	6.1	5.5	2.6	8.6	7.3	6.1	2.9	9.5	8.7	6.7	3.2	10.4	10.8
34	5.1	2.6	8.1	6.8	5.6	2.9	8.9	8.2	6.2	3.2	9.9	9.5	6.8	3.5	10.8	12.0
36	5.1	2.9	8.5	7.5	5.6	3.2	9.3	9.1	6.2	3.5	10.3	10.4	6.8	3.8	11.3	13.2
38	5.2	3.2	8.9	8.2	5.7	3.4	9.7	10.0	6.3	3.8	10.8	11.3	6.9	4.2	11.8	14.5
40	5.2	3.5	9.3	9.0	5.7	3.8	10.2	10.9	6.3	4.2	11.3	13.2	6.9	4.6	12.4	15.9
42	5.3	3.8	9.8	10.3	5.8	4.2	10.7	12.2	6.4	4.6	11.8	14.7	7.0	5.0	13.0	17.5
44	5.4	4.2	10.4	11.6	5.9	4.6	11.4	13.6	6.5	5.1	12.5	16.6	7.1	5.5	13.8	19.5
46	5.5	4.6	11.0	12.9	6.0	5.0	12.1	15.0	6.5	5.5	12.2	17.9	7.2	6.1	14.6	22.0
48	5.5	5.1	11.7	13.3	6.0	5.6	12.8	16.8	6.6	6.1	14.0	20.1	7.3	6.7	15.5	24.5
50	5.6	5.6	12.6	15.7	6.1	6.1	13.6	18.6	6.7	6.7	15.0	22.5	7.4	7.4	16.6	27.4
52	5.7	6.1	13.3	17.4	6.2	6.8	14.6	21.1	6.8	7.4	16.0	25.1	7.5	8.2	17.7	30.7
54	5.9	6.8	14.3	20.0	6.4	7.4	15.7	23.7	7.0	8.2	17.2	28.7	7.7	9.0	19.0	34.7
56	6.0	7.5	15.4	22.5	6.5	8.3	16.9	27.0	7.2	9.1	18.6	32.7	7.9	10.0	20.4	39.5
58	6.2	8.4	16.7	26.0	6.7	9.2	18.4	30.8	7.4	10.2	20.2	37.8	8.1	11.1	22.1	45.0
60	6.3	9.5	18.4	29.8	6.9	10.4	20.1	35.7	7.6	11.4	22.2	43.2	8.3	12.5	24.2	51.8
62	6.7	10.8	20.4	36.2	7.4	11.9	22.5	44.0	8.1	13.2	24.7	53.5	8.9	14.3	27.0	63.8
64	7.1	12.5	23.1	44.3	7.9	13.8	25.7	54.5	8.7	15.2	28.1	66.0	9.5	16.5	28.6	78.5
66	7.6	14.8	26.9	56.5	8.5	16.4	30.1	70.0	9.3	18.2	32.9	84.5	10.1	19.7	35.5	99.5
68	9.0	19.1	34.0	86.0	10.0	21.2	37.7	106.0	11.0	23.4	41.6	128.5	12.0	25.5	45.3	152.5

70	------	21.0	36.6	94.5	------	23.3	40.5	116.5	------	25.7	44.8	141.0	------	28.0	48.8	168.0
72	------	23.1	39.7	104.0	------	25.7	44.0	128.5	------	28.2	48.3	155.0	------	30.9	52.6	185.5
74	------	25.6	43.0	115.2	------	28.5	47.9	142.5	------	31.3	52.3	172.0	------	34.2	56.9	205.0
76	------	38.5	46.9	128.5	------	31.7	52.4	158.5	------	34.8	57.0	191.0	------	38.0	62.2	228.0
78	------	32.0	52.0	144.0	------	35.4	57.6	177.0	------	39.0	63.0	214.0	------	42.5	68.8	255.0
80	------	36.0	57.6	162.0	------	40.0	64.0	200.0	------	44.0	70.3	242.0	------	48.0	76.7	288.0
82	------	41.0	64.6	184.5	------	45.5	71.8	227.5	------	50.2	78.3	275.5	------	54.3	86.7	326.0
84	------	47.3	73.5	213.0	------	52.5	81.6	262.5	------	57.7	89.7	317.0	------	63.0	98.0	377.5
86	------	55.3	84.8	249.0	------	61.4	94.2	307.0	------	67.6	103.6	371.5	------	73.7	113.0	441.5
88	------	66.1	100.5	297.5	------	73.3	111.0	366.5	------	80.6	121.9	443.0	------	88.0	133.4	528.0
90	------	81.0	121.0	364.0	------	90.0	134.5	450.0	------	99.0	148.0	545.0	------	108.0	162.1	648.0
92	------	103.5	152.4	466.0	------	115.0	170.0	575.0	------	126.5	186.8	695.0	------	138.0	203.8	827.5
94	------	141.0	205.8	635.0	------	156.5	228.4	782.5	------	172.5	251.8	947.5	------	188.0	274.4	1,128.0
96	------	216.0	311.8	972.5	------	240.0	348.0	1,200.0	------	264.0	381.1	1,400.0	------	288.0	416.0	1,725.0
98	------	441.0	629.0	1,982.5	------	490.0	700.0	2,450.0	------	539.0	770.0	2,965.0	------	588.0	840.5	3,525.0
100	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------



B = distance, in feet, cut into hillside from grade stake to toe of cut slope.
C = vertical cut, in feet, to be marked on cut stake.
S = distance along slope, to be measured from grade stake to cut stake.
A = area, in square feet, of cut section.
W = width of finished road.

NOTE.—To obtain cubic yardage per 100 feet, multiply average end areas by 3.7.

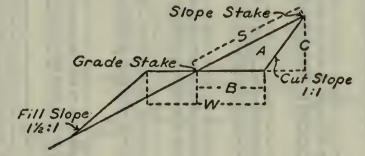
Table XVI.—SLOPE STAKES AND AREAS—Continued

[For use on Forest Service minor roads]

CUT SLOPE 1:1

Slope, %	Width of finished road															
	13				14				15				16			
	B	C	S	A	B	C	S	A	B	C	S	A	B	C	S	A
10	6.9	0.8	7.7	2.7	7.5	0.8	8.4	3.2	8.0	0.9	8.9	3.6	8.5	1.0	9.5	4.0
12	6.9	1.0	7.9	3.4	7.5	1.0	8.6	4.0	8.0	1.1	9.2	4.5	8.5	1.2	9.7	5.0
14	6.9	1.1	8.1	4.1	7.5	1.2	8.9	4.8	8.0	1.3	9.4	5.4	8.5	1.4	10.0	6.0
16	7.0	1.3	8.4	4.8	7.6	1.4	9.1	5.6	8.1	1.5	9.7	6.3	8.6	1.6	10.3	7.1
18	7.0	1.5	8.7	5.5	7.6	1.7	9.4	6.4	8.1	1.8	10.0	7.2	8.6	1.9	10.6	8.2
20	7.0	1.8	8.9	6.2	7.6	1.9	9.7	7.2	8.1	2.0	10.3	8.2	8.6	2.2	11.0	9.3
22	7.0	2.0	9.3	7.2	7.6	2.2	10.0	8.3	8.1	2.3	10.7	9.5	8.6	2.5	11.4	10.7
24	7.1	2.2	9.6	8.2	7.7	2.4	10.4	9.5	8.2	2.6	11.1	10.8	8.7	2.8	11.8	12.2
26	7.1	2.5	10.0	9.2	7.7	2.7	10.7	10.7	8.2	2.9	11.5	12.1	8.7	3.1	12.2	13.7
28	7.2	2.8	10.3	10.2	7.8	3.0	11.2	11.9	8.3	3.2	11.9	13.5	8.8	3.4	12.6	15.2
30	7.2	3.1	10.8	11.2	7.8	3.4	11.7	13.1	8.3	3.6	12.4	14.9	8.8	3.8	13.2	16.7
32	7.3	3.4	11.2	12.4	7.8	3.7	12.1	14.4	8.4	4.0	12.9	16.8	8.9	4.2	13.7	18.7
34	7.3	3.8	11.7	13.9	7.9	4.1	12.6	16.2	8.4	4.3	13.5	18.0	8.9	4.6	14.3	20.5
36	7.4	4.1	12.2	15.2	7.9	4.4	13.1	17.4	8.5	4.7	14.0	20.0	9.0	5.0	14.9	22.5
38	7.5	4.6	12.8	17.3	8.0	4.9	13.7	91.6	8.6	5.2	14.7	22.4	9.1	5.5	15.6	25.0
40	7.5	5.0	13.4	18.7	8.0	5.4	14.4	21.4	8.6	5.8	15.4	24.8	9.1	6.1	16.3	27.7
42	7.6	5.5	14.1	20.9	8.1	5.8	15.1	23.5	8.7	6.3	16.2	27.4	9.2	6.7	17.2	30.8
44	7.7	6.0	14.9	23.1	8.2	6.4	16.0	26.3	8.8	6.9	17.2	30.3	9.4	7.3	18.2	34.3
46	7.8	6.6	15.8	26.4	8.4	7.1	16.9	92.8	8.9	7.6	18.2	34.8	9.5	8.1	19.3	38.5
48	7.9	7.2	16.8	28.4	8.5	7.9	18.0	33.6	9.0	8.4	19.3	37.8	9.7	8.9	20.5	43.2
50	8.0	8.0	17.9	32.0	8.6	8.6	19.3	37.0	9.2	9.2	20.7	42.3	9.8	9.8	21.9	48.3
52	8.2	8.8	19.1	36.1	8.8	9.6	20.5	42.3	9.4	10.2	22.1	48.0	10.0	10.8	23.4	54.0
54	8.4	9.7	20.5	40.8	9.1	10.5	22.0	47.5	9.6	11.3	23.8	54.3	10.2	12.0	25.2	61.3
56	8.6	10.8	22.1	46.4	9.3	11.6	23.8	54.0	9.8	12.5	25.5	61.3	10.5	13.3	27.3	70.0
58	8.8	12.1	24.0	53.4	9.5	13.0	25.8	61.8	10.1	14.0	27.7	70.5	10.8	14.9	29.5	80.5
60	9.0	13.5	26.3	60.7	9.7	14.6	28.3	70.6	10.4	15.6	30.3	81.5	11.1	16.7	32.4	93.0
62	9.6	15.5	29.3	74.5	10.4	16.5	31.4	86.0	11.1	17.8	33.7	99.0	11.9	19.0	36.0	113.0
64	10.3	18.0	33.3	93.0	11.1	19.2	35.6	106.5	11.9	20.8	38.5	124.0	12.7	22.1	40.8	141.9
66	11.0	21.4	38.8	117.7	11.8	23.0	41.6	135.0	12.7	24.7	44.8	756.0	13.5	26.2	47.5	178.0
68	13.0	27.6	49.0	179.5	14.0	29.8	52.8	208.5	15.0	31.9	56.6	239.0	16.0	34.0	60.3	272.0

70	------	30.3	52.7	192.0	------	32.7	56.8	228.5	------	35.0	60.8	263.0	------	37.3	64.8	298.0
72	------	33.4	57.0	217.0	------	36.0	61.5	252.0	------	38.6	65.9	289.0	------	41.2	70.2	333.0
74	------	37.0	61.7	240.5	------	39.8	66.6	278.5	------	42.7	71.3	320.0	------	45.6	76.6	364.0
76	------	41.2	67.4	267.5	------	44.3	72.7	310.0	------	47.5	77.8	356.0	------	50.7	83.9	405.0
78	------	46.1	74.5	299.0	------	49.7	80.4	347.5	------	53.2	86.0	399.0	------	56.8	92.3	454.0
80	------	52.0	84.0	337.5	------	56.0	89.6	391.5	------	60.0	97.0	450.0	------	64.0	102.5	512.0
82	------	59.3	93.0	387.5	------	63.8	100.0	446.0	------	67.4	107.0	505.0	------	72.8	114.8	584.0
84	------	68.3	106.0	444.0	------	73.5	114.2	514.0	------	78.8	122.0	591.0	------	84.0	130.0	672.5
86	------	79.8	123.0	519.0	------	86.0	132.0	602.0	------	92.2	142.0	691.0	------	98.3	150.9	788.0
88	------	95.2	144.0	619.0	------	102.8	155.6	720.0	------	110.0	166.0	825.0	------	117.2	177.6	938.0
90	------	117.0	175.0	760.0	------	126.0	188.1	881.0	------	135.0	202.0	1,011.0	------	144.0	215.2	1,150.0
92	------	149.5	221.2	971.0	------	161.0	237.7	1,130.0	------	172.5	256.0	1,295.0	------	184.0	274.0	1,475.0
94	------	203.3	297.0	1,320.0	------	219.0	320.0	1,531.0	------	235.0	343.0	1,760.0	------	250.5	366.0	2,000.0
96	------	312.0	451.0	2,025.0	------	336.0	485.3	2,350.0	------	360.0	529.0	2,700.0	------	384.0	554.5	3,070.0
98	------	637.0	910.0	4,135.0	------	685.0	978.6	4,790.0	------	735.0	1,050	5,510.0	------	785.0	1,121	6,290.0
100	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------



B = distance, in feet, cut into hillside from grade stake to toe of cut slope.
C = vertical cut, in feet, to be marked on cut stake.
S = distance along slope, to be measured from grade stake to cut stake.
A = area, in square feet, of cut section.
W = width of finished road.

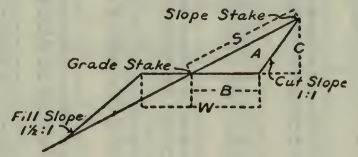
NOTE.—To obtain cubic yardage per 100 feet, multiply average end areas by 3.7.

Table XVI.—SLOPE STAKES AND AREAS—Continued

[For use on Forest Service minor roads] CUT SLOPE 1:1

Slope, percent	Width of finished road															
	17				18				19				20			
	B	C	S	A	B	C	S	A	B	C	S	A	B	C	S	A
10	9.0	1.0	10.0	4.5	9.6	1.0	10.8	4.8	10.1	1.1	11.2	5.5	10.6	1.2	11.8	6.3
12	9.0	1.2	10.4	5.4	9.6	1.4	11.0	6.7	10.1	1.3	11.6	6.6	10.6	1.4	12.2	7.4
14	9.0	1.5	10.7	6.7	9.6	1.6	11.4	7.7	10.1	1.7	12.0	8.6	10.6	1.8	12.6	9.5
16	9.2	1.7	10.9	7.8	9.8	1.8	11.6	8.8	10.2	1.9	12.2	9.7	10.8	2.0	12.8	10.8
18	9.2	2.1	11.2	9.7	9.8	2.2	12.0	10.8	10.2	2.3	12.6	11.7	10.8	2.4	13.2	13.0
20	9.2	2.4	11.7	11.0	9.8	2.4	12.4	11.8	10.2	2.7	13.2	13.8	10.8	2.8	13.8	15.1
22	9.2	2.6	12.2	12.0	9.8	2.8	12.8	13.7	10.2	2.9	13.7	14.8	10.8	3.0	14.4	16.2
24	9.2	2.9	12.6	13.3	9.8	3.2	13.4	15.7	10.2	3.2	14.1	16.3	10.8	3.4	14.8	18.4
26	9.4	3.2	12.9	15.0	10.0	3.4	13.8	17.0	10.4	3.6	14.5	18.7	11.0	3.8	15.2	20.9
28	9.4	3.6	13.4	16.9	10.0	3.8	14.4	19.0	10.4	4.0	15.0	20.8	11.0	4.2	15.8	23.1
30	9.4	4.1	13.9	19.3	10.0	4.2	15.0	21.0	10.4	4.6	15.6	23.9	11.0	4.8	16.4	26.4
32	9.4	4.4	14.6	20.7	10.0	4.8	15.6	24.0	10.4	4.9	16.4	25.5	11.0	5.2	17.2	28.6
34	9.5	4.9	15.1	23.4	10.2	5.2	16.2	26.5	10.6	5.5	16.9	29.1	11.2	5.8	17.8	32.5
36	9.5	5.4	15.8	25.6	10.2	5.8	17.0	29.6	10.6	6.1	17.7	32.3	11.2	6.4	18.6	35.8
38	9.7	5.8	16.5	28.0	10.4	6.4	17.8	33.3	10.8	6.5	18.5	35.0	11.4	6.8	19.4	38.8
40	9.7	6.5	17.4	31.5	10.4	7.0	18.6	36.4	10.8	7.2	19.4	38.8	11.4	7.6	20.4	43.3
42	9.9	7.2	18.2	35.6	10.6	7.6	19.6	40.3	11.0	8.0	20.4	44.0	11.6	8.4	21.4	48.7
44	10.0	7.9	19.4	39.5	10.8	8.4	20.8	45.4	11.2	8.7	21.7	48.6	11.8	9.2	22.8	54.3
46	10.2	8.5	20.5	43.2	11.0	9.2	22.0	50.6	11.4	9.5	23.0	50.8	12.0	10.0	24.2	60.0
48	10.2	9.5	21.8	48.5	11.0	10.2	23.4	56.1	11.4	10.6	24.4	60.4	12.0	11.2	25.6	67.2
50	10.4	10.4	23.1	50.8	11.2	11.2	25.2	62.7	11.6	11.6	25.9	67.0	12.2	12.2	27.2	74.4
52	10.6	11.6	24.8	63.0	11.4	12.2	26.6	69.5	11.8	12.9	27.8	76.0	12.4	13.6	29.2	84.3
54	10.9	12.6	26.7	68.7	11.8	13.6	28.6	80.2	12.2	14.1	29.9	86.0	12.8	14.8	31.4	94.7
56	11.0	14.2	28.8	78.0	12.0	15.0	30.8	90.0	12.4	15.8	32.2	98.0	13.0	16.6	33.8	107.9
58	11.4	15.6	31.3	89.0	12.4	16.8	33.4	104.2	12.7	17.5	35.0	111.0	13.4	18.4	36.8	123.3
60	11.7	17.7	34.2	103.6	12.6	19.0	36.8	119.7	13.1	19.8	38.2	130.0	13.8	20.8	40.2	139.8
62	12.6	20.3	38.3	128.0	13.4	21.6	40.8	144.7	14.0	22.6	42.9	158.0	14.8	23.8	45.0	176.1
64	13.4	23.5	43.7	157.5	14.2	25.0	46.2	177.5	15.0	26.2	49.0	196.0	15.8	27.6	51.4	218.0
66	14.4	27.9	51.2	200.0	15.2	29.6	53.8	225.0	16.2	31.3	57.4	254.0	17.0	32.8	60.2	278.8
68	17.0	36.0	64.0	305.0	18.0	38.2	68.0	343.8	19.0	40.3	72.0	382.8	20.0	42.4	75.4	424.0

70	39.6	69.0	337.0		42.0	73.2	378.0		44.4	77.0	421.8		46.6	81.0	466.0
72	43.7	74.9	371.5		46.2	79.4	415.8		48.7	84.0	462.6		51.4	88.0	514.0
74	48.5	81.2	412.0		51.2	86.0	460.8		54.2	91.0	514.9		57.0	95.8	570.0
76	54.0	89.0	460.0		57.0	93.8	513.0		60.5	99.7	574.9		63.4	104.8	634.0
78	60.0	96.8	510.0		64.0	104.0	576.0		67.1	109.8	637.4		70.8	115.2	708.0
80	68.0	108.3	580.0		72.0	115.2	648.0		76.0	122.0	722.0		80.0	128.0	800.0
82	77.5	122.0	660.0		82.0	129.2	738.0		86.5	136.0	821.7		91.0	143.6	910.0
84	89.1	138.0	760.0		94.6	147.0	851.4		99.8	155.0	948.1		105.0	163.2	1,050.0
86	104.1	160.0	884.0		110.6	169.6	995.4		116.2	178.8	1,103.9		122.8	188.4	1,228.0
88	125.0	188.0	1,060.0		132.2	201.0	1,189.8		140.0	211.0	1,330.0		146.6	222.0	1,466.0
90	153.0	228.0	1,300.0		162.0	242.0	1,458.0		171.0	255.0	1,624.5		180.0	269.0	1,800.0
92	196.0	289.0	1,660.0		207.0	304.8	1,863.0		219.0	323.0	2,080.5		230.0	340.0	2,300.0
94	266.0	387.0	2,260.0		282.0	411.6	2,052.0		297.0	435.0	2,821.5		313.0	456.8	3,130.0
96	408.0	592.0	3,460.0		432.0	623.6	3,888.0		456.0	660.0	4,332.0		480.0	496.0	4,800.0
98	833.0	1,183.0	7,080.5		882.0	1,258.0	7,938.0		931.0	1,330.0	8,844.5		980.0	980.0	9,800.0
100															



B=distance, in feet, cut into hillside from grade stake to toe of cut slope.
C=vertical cut, in feet, to be marked on cut stake.
S=distance along slope, to be measured from grade stake to cut stake.
A=area, in square feet, of cut section.
W=width of finished road.

NOTE.—To obtain cubic yardage per 100 feet, multiply average end areas by 3.7.

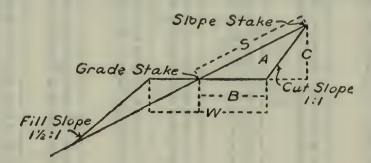
TABLE XVI.—SLOPE STAKES AND AREAS—Continued

[For use on Forest Service minor roads]

CUT SLOPE 1:1

Slope, percent	Width of finished road															
	21				22				23				24			
	B	C	S	A	B	C	S	A	B	C	S	A	B	C	S	A
10	11.2	1.3	12.4	7.3	11.8	1.4	13.2	8.3	12.2	1.4	13.6	8.5	13.0	1.4	14.4	9.1
12	11.2	1.5	12.8	8.4	11.8	1.6	13.6	9.4	12.2	1.6	14.0	9.8	13.0	1.8	14.8	11.7
14	11.2	1.9	13.2	10.6	11.8	2.0	14.0	11.8	12.2	2.1	14.5	12.8	13.0	2.2	15.2	14.3
16	11.4	2.1	13.4	12.0	12.0	2.4	14.4	14.4	12.4	2.3	14.7	14.3	13.0	2.4	15.6	15.6
18	11.4	2.5	13.9	14.2	12.0	2.6	14.8	15.6	12.4	2.8	15.2	17.4	13.0	2.8	16.0	18.2
20	11.4	2.9	14.5	16.5	12.0	3.0	15.2	18.0	12.4	3.2	15.9	19.8	13.0	3.2	16.6	20.8
22	11.4	3.2	15.1	18.2	12.0	3.4	15.8	20.4	12.4	3.5	16.6	21.7	13.0	3.8	17.2	24.7
24	11.4	3.6	15.5	20.5	12.0	3.8	16.4	22.8	12.4	3.9	17.0	24.2	13.2	4.2	17.8	27.7
26	11.6	4.0	16.0	23.2	12.2	4.2	17.0	25.6	12.7	4.4	17.5	27.9	13.2	4.6	18.4	40.4
28	11.6	4.4	16.6	25.5	12.2	4.8	17.6	29.3	12.7	4.8	18.2	30.5	13.4	5.2	19.2	34.8
30	11.6	5.1	17.2	29.6	12.2	5.2	18.2	31.7	12.7	5.5	18.9	34.9	13.4	5.8	20.0	38.9
32	11.6	5.5	18.0	31.9	12.2	5.8	19.0	35.4	12.7	6.0	19.8	38.1	13.4	6.4	20.8	42.9
34	11.8	6.1	18.7	36.0	12.4	6.4	19.8	39.7	12.9	6.7	20.5	43.2	13.6	7.0	21.6	47.6
36	11.8	6.7	19.5	39.5	12.4	7.0	20.6	43.4	12.9	7.4	21.4	47.7	13.6	7.6	22.6	51.7
38	12.0	7.2	20.4	43.2	12.6	7.6	21.6	47.9	13.1	7.8	22.3	51.1	13.8	8.4	23.6	58.0
40	12.0	8.0	21.5	48.0	12.6	8.4	22.6	52.9	13.1	8.7	23.5	57.0	13.8	9.2	24.8	63.5
42	12.2	8.8	22.5	53.7	12.8	9.2	23.6	58.9	13.3	9.7	24.6	64.5	14.0	10.0	26.0	70.0
44	12.4	9.7	24.0	60.1	13.0	10.2	25.0	66.3	13.6	10.6	26.2	72.1	14.2	11.0	27.6	78.1
46	12.6	10.5	25.4	66.1	13.0	11.0	26.4	71.5	13.8	11.5	27.8	79.4	14.4	12.2	29.2	87.8
48	12.6	11.8	26.9	74.3	13.2	12.2	28.0	80.5	13.8	12.9	29.4	89.0	14.6	13.4	31.0	97.8
50	12.8	12.8	28.5	81.9	13.4	13.4	30.0	89.8	14.0	14.0	31.3	98.0	14.8	14.8	33.2	109.5
52	13.0	14.3	30.6	92.9	13.6	14.8	32.0	100.6	14.3	15.6	33.6	119.3	15.0	16.4	35.4	123.0
54	13.4	15.5	33.0	103.8	14.0	16.4	34.4	114.8	14.7	17.0	36.1	125.0	15.4	18.0	38.0	138.6
56	13.6	17.4	35.5	118.3	14.4	18.2	37.2	131.0	14.9	19.1	38.9	142.3	15.8	20.0	40.8	158.0
58	14.0	19.3	38.6	135.1	14.8	20.4	40.4	151.0	15.4	21.2	42.3	163.2	16.2	22.2	44.2	179.8
60	14.5	21.8	42.3	158.1	15.2	22.8	44.4	173.3	15.9	23.9	46.2	190.0	16.6	25.0	48.4	207.5
62	15.6	25.0	46.3	195.0	16.2	26.4	49.4	213.8	17.0	27.4	51.8	232.9	17.8	28.6	54.0	254.5
64	16.6	29.0	50.8	240.7	17.4	30.4	56.2	264.5	18.2	31.7	59.1	288.5	19.0	33.0	57.2	313.5
66	17.8	34.5	63.3	307.1	18.6	36.4	65.8	338.5	19.6	37.7	69.2	369.5	20.2	39.4	71.0	397.9
68	21.0	44.6	79.1	468.3	22.0	46.8	83.2	514.8	23.0	48.8	86.7	488.0	24.0	51.0	90.6	612.0

70	------	49.0	85.0	514.5	------	51.4	89.6	565.4	------	53.6	93.2	616.4	------	56.0	97.6	672.0
72	------	54.0	92.8	567.0	------	56.4	96.6	620.4	------	59.1	101.2	679.7	------	61.8	105.2	741.6
74	------	60.0	100.5	630.0	------	62.6	104.6	688.6	------	65.6	114.3	754.4	------	68.4	113.8	820.8
76	------	67.0	110.0	703.5	------	69.6	114.0	765.6	------	72.9	120.5	838.4	------	76.0	124.4	912.0
78	------	74.5	120.9	782.2	------	78.0	126.0	858.0	------	81.4	132.5	936.1	------	85.0	137.6	1,020.0
80	------	84.0	134.7	882.0	------	88.0	140.6	968.0	------	92.0	147.2	1,058.0	------	96.0	153.4	1,152.0
82	------	95.5	150.0	1,002.7	------	100.4	156.6	1,104.4	------	104.7	165.1	1,204.1	------	108.6	173.4	1,303.2
84	------	110.3	172.0	1,158.1	------	115.4	179.4	1,269.4	------	120.8	187.7	1,382.2	------	126.0	196.0	1,512.0
86	------	129.0	198.0	1,354.5	------	135.2	207.2	1,487.2	------	141.2	216.6	1,623.8	------	147.4	226.0	1,768.8
88	------	154.0	233.0	1,617.0	------	161.2	243.8	1,773.2	------	168.6	255.3	1,938.9	------	176.0	266.8	2,112.0
90	------	189.5	281.0	1,989.7	------	198.0	296.0	2,178.0	------	207.0	309.4	2,380.5	------	216.0	324.2	2,592.0
92	------	241.0	357.0	2,530.5	------	253.0	372.6	2,783.0	------	264.5	391.0	3,041.8	------	276.0	407.6	3,312.0
94	------	329.0	480.0	3,454.5	------	345.0	503.6	3,795.0	------	360.0	525.3	4,140.0	------	376.0	548.8	4,512.0
96	------	504.0	730.0	5,292.0	------	528.0	762.2	5,808.0	------	552.0	800.4	6,348.0	------	576.0	832.0	6,912.0
98	------	1,029.0	1,470.0	10,804.5	------	1,078.0	1,540.0	11,858.0	------	1,127.0	1,610.0	12,960.5	------	1,176.0	1,176.0	14,112.0
100	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------



B=distance, in feet, cut into hillside from grade stake to toe of cut slope.
C=vertical cut, in feet, to be marked on cut stake.
S=distance along slope, to be measured from grade stake to cut stake.
A=area, in square feet, of cut section.
W=width of finished road.

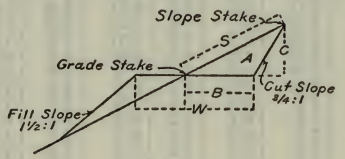
NOTE.—To obtain cubic yardage per 100 feet, multiply average end areas by 3.7.

Table XVI.—SLOPE STAKES AND AREAS—Continued

[For use on Fosest Service minor roads] CUT SLOPE ¾:1

Slope, percent	Width of finished road															
	9				10				11				12			
	B	C	S	A	B	C	S	A	B	C	S	A	B	C	S	A
10	4.9	0.5	5.3	1.3	5.4	0.6	5.9	1.6	6.0	0.7	6.5	2.0	6.5	0.7	7.1	2.3
12	4.9	0.7	5.4	1.6	5.4	0.7	6.0	2.0	6.0	0.8	6.7	2.4	6.5	0.9	7.2	2.8
14	4.9	0.8	5.6	1.9	5.4	0.9	6.1	2.4	6.0	1.0	6.8	2.9	6.5	1.0	7.4	3.4
16	5.0	0.9	5.7	2.2	5.5	1.0	6.3	2.8	6.1	1.1	7.0	3.3	6.6	1.2	7.6	3.9
18	5.0	1.0	5.8	2.6	5.5	1.2	6.4	3.2	6.1	1.3	7.1	3.8	6.6	1.4	7.7	4.5
20	5.0	1.2	6.0	2.9	5.5	1.3	6.6	3.6	6.1	1.4	7.3	4.3	6.6	1.6	7.9	5.1
22	5.0	1.3	6.1	3.3	5.5	1.5	6.8	4.1	6.1	1.6	7.5	4.9	6.6	1.8	8.1	5.7
24	5.0	1.5	6.3	3.7	5.6	1.6	7.0	4.6	6.1	1.8	7.7	5.6	6.7	2.0	8.4	6.5
26	5.1	1.6	6.5	4.1	5.6	1.8	7.2	5.1	6.2	2.0	7.9	6.3	6.7	2.2	8.6	7.2
28	5.1	1.8	6.7	4.6	5.7	2.0	7.4	5.7	6.2	2.2	8.2	6.9	6.8	2.4	8.9	8.0
30	5.1	2.0	6.9	5.0	5.7	2.2	7.7	6.2	6.2	2.5	8.4	7.6	6.8	2.6	9.2	8.8
32	5.1	2.2	7.1	5.6	5.7	2.4	7.9	6.9	6.2	2.7	8.7	8.5	6.8	2.9	9.5	9.9
34	5.2	2.4	7.3	6.2	5.8	2.6	8.2	7.7	6.3	2.9	9.0	9.4	6.9	3.2	9.8	11.0
36	5.2	2.6	7.6	6.8	5.8	2.9	8.4	8.4	6.3	3.2	9.3	10.3	7.0	3.4	10.1	12.1
38	5.3	2.8	7.9	7.4	5.9	3.1	8.7	9.2	6.4	3.4	9.7	11.1	7.0	3.7	10.5	13.2
40	5.3	3.0	8.2	8.0	5.9	3.4	9.1	9.9	6.5	3.7	10.0	12.0	7.1	4.1	10.9	14.4
42	5.4	3.3	8.5	9.0	6.0	3.7	9.5	11.1	6.6	4.0	10.4	13.4	7.2	4.4	11.3	15.8
44	5.5	3.6	8.9	10.0	6.1	4.0	9.9	13.2	6.7	4.4	10.9	14.8	7.4	4.8	11.9	17.8
46	5.6	3.9	9.3	11.1	6.3	4.4	10.4	13.9	6.9	4.8	11.5	16.6	7.5	5.2	12.5	19.5
48	5.7	4.3	9.8	12.2	6.4	4.8	10.9	15.4	7.0	5.2	12.0	18.2	7.6	5.7	13.1	21.7
50	5.8	4.6	10.4	13.3	6.5	5.2	11.6	16.9	7.1	5.7	12.7	20.2	7.7	6.2	13.8	23.8
52	5.9	5.0	10.9	14.7	6.6	5.6	12.2	18.5	7.3	6.2	13.3	22.6	7.9	6.8	14.6	26.8
54	6.1	5.5	11.5	16.8	6.8	6.1	12.8	20.8	7.5	6.7	14.1	25.1	8.1	7.3	15.4	29.5
56	6.3	5.9	12.2	18.6	7.0	6.7	13.6	23.5	7.6	7.3	14.9	27.8	8.3	7.9	16.3	32.8
58	6.4	6.5	13.0	20.8	7.1	7.2	14.4	25.5	7.8	8.0	15.9	31.2	8.5	8.6	17.3	36.5
60	6.5	7.1	13.8	23.0	7.3	7.9	15.5	28.8	8.0	8.7	17.0	34.8	8.7	9.5	18.4	41.3
62	7.0	7.9	15.0	27.7	7.7	8.8	16.7	33.4	8.5	9.7	18.3	41.2	9.2	10.5	19.9	48.2
64	7.4	8.9	16.4	32.9	8.2	9.9	18.3	40.6	9.0	10.9	20.1	49.0	9.8	11.8	21.8	58.0
66	7.8	10.2	18.5	39.8	8.7	11.4	20.6	49.4	9.6	12.5	22.8	60.0	10.4	13.6	24.7	71.5
68	9.0	12.5	22.2	56.3	10.0	13.9	24.7	69.5	11.0	15.3	27.2	84.0	12.0	16.7	29.6	101.0
70	------	13.3	23.1	60.0	------	14.8	25.7	74.0	------	16.3	28.3	89.5	------	17.7	30.9	106.0

72	------	14.1	24.1	63.5	------	15.6	28.9	78.0	------	17.3	29.4	94.5	------	18.8	32.1	113.0
74	------	14.9	25.1	67.0	------	16.6	29.6	83.0	------	18.4	30.8	101.0	------	20.0	33.5	120.0
76	------	15.9	26.0	71.6	------	17.7	30.4	88.5	------	19.5	32.1	107.0	------	21.3	35.0	127.5
78	------	16.9	27.4	76.0	------	18.8	31.2	94.0	------	20.7	33.3	114.0	------	22.6	36.6	135.5
80	------	18.0	28.9	81.0	------	20.0	32.0	100.0	------	22.1	35.2	121.5	------	24.1	38.6	144.5
82	------	19.1	30.2	86.0	------	21.4	33.6	107.0	------	23.5	37.0	129.0	------	25.7	40.3	154.0
84	------	20.3	31.6	91.5	------	22.9	35.2	114.5	------	25.1	39.0	138.0	------	27.3	42.3	164.0
86	------	21.9	33.6	98.5	------	24.3	37.0	121.5	------	26.8	41.0	147.5	------	29.1	44.6	174.5
88	------	23.1	35.2	104.0	------	26.0	39.1	130.0	------	28.6	43.4	157.0	------	31.1	47.2	186.5
90	------	25.0	37.4	112.5	------	27.8	41.4	139.0	------	30.7	46.0	169.0	------	33.3	49.8	200.0
92	------	26.9	39.7	121.0	------	29.8	44.0	149.0	------	32.9	48.7	181.0	------	35.8	52.8	215.0
94	------	28.8	42.1	129.5	------	32.1	46.5	160.5	------	35.4	51.6	194.5	------	38.6	56.2	231.0
96	------	31.0	44.8	139.5	------	34.6	49.8	173.0	------	38.1	54.7	209.0	------	41.4	60.5	248.5
98	------	33.5	48.0	150.5	------	37.2	53.2	186.0	------	41.0	58.6	225.0	------	44.6	64.4	267.5
00	------	36.3	51.4	163.5	------	40.3	57.0	201.5	------	44.4	62.8	244.0	------	48.4	68.4	290.0
1																



B=distance, in feet, cut into hillside from grade stake to toe of cut slope.
C=verical cut, in feet, to be marked on cut stake.
S=distance along slope, to be measured from grade stake to cut stake.
A=area, in square feet, of cut section.
W=width of finished road.

NOTE.—To obtain cubic yardage per 100 feet, multiply average end areas by 3.7.

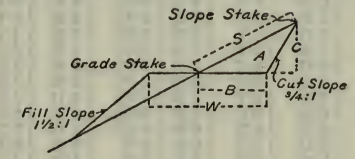
Table XVI.—SLOPE STAKES AND AREAS—Continued

[For use on Forest Service minor roads]

CUT SLOPE ¾:1

Slope, percent	Width of finished road															
	13				14				15				16			
	B	C	S	A	B	C	S	A	B	C	S	A	B	C	S	A
10	7.0	0.7	7.6	2.6	7.6	0.8	8.2	3.1	8.0	0.9	8.7	3.6	8.5	0.9	9.2	3.9
12	7.0	0.9	7.8	3.3	7.5	1.0	8.3	3.8	8.0	1.1	8.9	4.4	8.5	1.1	9.4	4.9
14	7.0	1.1	7.9	4.0	7.6	1.2	8.5	4.6	8.1	1.3	9.1	5.2	8.6	1.3	9.7	5.9
16	7.1	1.3	8.1	4.6	7.6	1.4	8.7	5.3	8.1	1.5	9.3	6.1	8.6	1.6	9.9	6.8
18	7.1	1.5	8.3	5.3	7.7	1.6	9.0	6.1	8.2	1.7	9.6	7.0	8.7	1.8	10.2	7.8
20	7.1	1.7	8.5	6.0	7.7	1.8	9.2	6.9	8.2	1.9	9.8	7.9	8.7	2.0	10.4	8.8
22	7.1	1.9	8.8	6.9	7.7	2.0	9.4	7.9	8.2	2.2	10.1	9.1	8.7	2.3	10.7	10.2
24	7.2	2.1	9.0	7.7	7.8	2.3	9.7	8.9	8.3	2.4	10.4	10.3	8.8	2.6	11.0	11.6
26	7.2	2.4	9.3	8.5	7.8	2.5	10.0	10.0	8.4	2.7	10.7	11.5	8.9	2.9	11.4	13.0
28	7.3	2.6	9.6	9.4	7.9	2.8	10.3	11.0	8.5	3.0	11.0	12.7	8.9	3.2	11.7	14.4
30	7.3	2.8	9.9	10.3	7.9	3.1	10.6	12.1	8.5	3.3	11.4	14.0	9.0	3.5	12.2	15.8
32	7.4	3.1	10.2	11.5	8.0	3.4	11.0	13.4	8.6	3.6	11.8	15.5	9.1	3.8	12.6	17.3
34	7.4	3.4	10.6	12.7	8.1	3.7	11.4	14.9	9.7	3.9	12.2	17.0	9.2	4.2	13.0	19.3
36	7.5	3.7	10.9	14.0	8.1	4.0	11.8	16.3	8.7	4.3	12.7	18.7	9.3	4.6	13.5	21.4
38	7.6	4.1	11.3	15.6	8.2	4.4	12.3	17.8	8.8	4.7	13.2	20.7	9.4	5.0	14.0	23.5
40	7.7	4.4	11.8	17.0	8.3	4.7	12.8	19.4	8.9	5.1	13.7	23.0	9.5	5.4	14.6	25.7
42	7.8	4.8	12.3	18.7	8.4	5.3	13.3	22.2	9.0	5.5	14.3	24.8	9.6	5.9	15.2	28.8
44	8.0	5.2	12.9	20.8	8.6	5.6	13.9	24.0	9.3	6.0	15.0	27.9	9.8	6.4	15.9	31.4
46	8.1	5.7	13.5	23.3	8.7	6.1	14.6	26.5	9.4	6.5	15.7	30.6	10.0	7.0	16.6	35.0
48	8.3	6.2	14.2	25.8	8.9	6.6	15.3	29.4	9.6	7.1	16.5	34.1	10.1	7.6	17.5	38.4
50	8.4	6.7	15.0	28.1	9.0	7.2	16.1	32.4	9.7	7.8	17.3	37.6	10.3	8.3	18.5	42.8
52	8.6	7.3	15.8	31.4	9.2	7.8	17.0	35.9	9.9	8.4	18.3	41.5	10.5	9.0	19.4	47.3
54	8.8	7.9	16.6	34.8	9.5	8.6	18.0	40.8	10.2	9.2	19.3	47.0	10.8	9.8	20.5	53.0
56	9.0	8.6	17.6	38.3	9.7	9.3	19.0	45.1	10.4	10.0	20.4	52.0	11.1	10.6	21.7	59.0
58	9.2	9.4	18.7	43.3	10.0	10.2	20.1	51.0	10.7	10.9	21.7	58.5	11.4	11.6	23.0	66.0
60	9.4	10.2	19.9	48.0	10.2	11.1	21.5	56.5	10.9	11.9	23.1	65.0	11.6	12.7	24.6	73.5
62	10.0	11.4	21.5	57.0	10.8	12.2	23.2	66.0	11.6	13.2	24.9	76.5	12.3	14.0	26.5	86.0
64	10.6	12.8	22.7	68.0	11.5	13.7	25.4	78.8	12.3	14.7	27.3	90.5	13.1	15.6	29.0	102.0
66	11.3	14.8	26.8	83.5	12.1	15.8	28.8	95.5	13.0	17.0	30.9	111.0	13.9	18.2	33.0	126.5
68	13.0	18.1	32.1	117.5	14.0	19.5	34.6	136.5	15.0	20.8	37.0	156.0	16.0	22.3	39.6	178.5
70	------	19.2	33.4	125.0	------	20.6	35.0	144.0	------	22.1	38.5	165.0	------	23.7	41.3	189.5

72	20.5	34.8	133.5		21.9	37.4	153.0		23.5	40.1	176.0		25.1	43.0	201.0
74	21.7	36.3	141.0		23.3	39.0	163.0		24.9	41.8	187.0		26.7	44.6	213.5
76	23.1	37.9	150.0		24.8	40.8	173.5		26.6	43.8	199.5		28.4	46.6	227.0
78	24.4	39.7	158.5		26.4	42.7	184.5		28.2	45.9	211.5		30.2	48.8	241.5
80	26.1	41.7	169.5		28.1	45.0	197.0		30.0	48.0	225.0		32.1	51.4	257.0
82	27.8	43.8	180.5		29.9	47.1	209.0		32.1	50.5	241.0		34.2	54.0	273.5
84	29.9	46.2	194.0		31.9	49.3	223.5		34.2	53.1	256.0		36.5	56.7	292.0
86	31.7	48.6	206.0		34.1	52.0	238.5		36.6	56.0	274.0		39.0	59.7	312.0
88	33.8	51.2	219.5		36.4	54.9	254.5		39.0	59.0	292.5		41.7	63.2	333.0
90	36.3	54.1	236.0		39.0	58.2	273.0		41.7	62.0	312.5		44.5	66.6	356.0
92	38.8	57.3	252.0		41.7	61.4	291.0		44.7	66.0	335.0		47.8	70.0	382.5
94	41.7	60.7	271.0		44.8	65.4	313.5		48.0	70.0	360.0		51.3	74.8	410.0
96	44.8	64.7	291.0		48.3	69.6	338.0		51.8	74.8	388.0		55.2	79.9	440.0
98	48.4	69.0	314.0		52.0	74.3	363.5		55.9	79.9	419.0		59.6	85.3	477.0
100	52.4	74.2	340.0		56.4	79.8	394.0		60.5	85.5	453.0		64.5	91.2	516.0



B=distance, in feet, cut into hillside from grade stake to toe of cut slope.
C=vertical cut, in feet, to be marked on cut stake.
S=distance along slope, to be measured from grade stake to cut stake.
A=area, in square feet, of cut section.
W=width of finished road.

NOTE.—To obtain cubic yardage per 100 feet, multiply average end areas by 3.7.

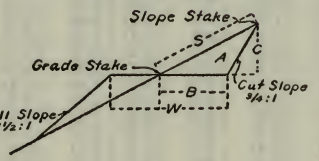
Table XVI.—SLOPE STAKES AND AREAS—Continued

[For use on Forest Service minor roads]

CUT SLOPE ¾:1

Slope, percent	Width of finished road															
	17				18				19				20			
	B	C	S	A	B	C	S	A	B	C	S	A	B	C	S	A
10	9.2	1.0	10.0	4.6	9.8	1.0	10.6	4.9	10.2	1.1	11.2	5.6	10.8	1.2	11.8	6.5
12	9.2	1.2	10.2	5.5	9.8	1.4	10.8	6.9	10.2	1.3	11.4	6.6	10.8	1.4	12.0	7.6
14	9.2	1.5	10.4	6.9	9.8	1.6	11.2	7.8	10.2	1.7	11.6	8.7	10.8	1.8	12.2	9.7
16	9.4	1.7	10.7	8.0	10.0	1.8	11.4	9.0	10.4	1.9	12.0	9.9	11.0	2.0	12.6	11.0
18	9.4	2.0	10.9	9.4	10.0	2.0	11.6	10.0	10.4	2.3	12.2	12.0	11.0	2.4	12.8	13.2
20	9.4	2.2	11.2	10.3	10.0	2.4	12.0	12.0	10.4	2.5	12.6	13.0	11.0	2.6	13.2	14.3
22	9.4	2.3	11.6	10.8	10.0	2.6	12.2	13.0	10.4	2.8	12.9	14.6	11.0	3.0	13.6	16.5
24	9.5	2.7	11.9	12.8	10.0	3.0	12.6	15.0	10.6	3.0	13.3	15.9	11.2	3.2	14.0	17.9
26	9.5	3.1	12.2	14.7	10.2	3.2	13.0	16.3	10.6	3.4	13.7	18.0	11.2	3.6	14.4	20.2
28	9.7	3.4	12.6	16.5	10.2	3.6	13.4	18.4	10.8	3.8	14.1	20.5	11.4	4.0	14.8	22.8
30	9.7	3.7	13.1	17.9	10.2	4.0	13.8	20.4	10.8	4.2	14.6	22.7	11.4	4.4	15.4	25.1
32	9.7	4.1	13.4	19.9	10.2	4.4	14.2	22.4	10.8	4.6	15.0	24.8	11.4	4.8	15.8	27.4
34	9.8	4.4	13.9	21.6	10.4	4.8	14.6	25.0	11.0	4.9	15.6	26.9	11.6	5.2	16.4	29.7
36	9.8	4.9	14.2	24.0	10.4	5.2	15.2	27.0	11.0	5.5	15.9	30.3	11.6	5.8	16.8	33.2
38	10.0	5.3	14.8	26.5	10.6	5.6	15.8	29.2	11.2	5.9	16.6	33.0	11.8	6.2	17.4	36.6
40	10.0	5.8	15.4	29.0	10.6	6.0	16.4	31.3	11.2	6.5	17.3	36.4	11.8	6.8	18.2	40.1
42	10.2	6.3	16.2	32.1	10.8	6.6	17.0	35.6	11.4	7.0	18.0	39.9	12.0	7.4	19.0	44.4
44	10.4	6.8	16.8	35.4	11.0	7.2	17.8	39.6	11.6	7.6	18.8	44.1	12.2	8.0	19.8	48.8
46	10.7	7.5	17.6	43.9	11.2	7.8	18.6	43.7	12.0	8.4	19.7	50.4	12.6	8.8	20.8	55.4
48	10.9	8.2	18.5	44.7	11.4	8.6	19.6	49.0	12.2	9.1	20.8	55.5	12.8	9.6	21.8	61.4
50	11.0	8.8	19.7	48.4	11.6	9.2	20.8	53.4	12.4	9.9	22.0	61.4	13.0	10.4	23.2	67.6
52	11.2	9.5	20.7	53.2	11.8	10.0	21.8	59.0	12.6	10.6	23.1	66.8	13.2	11.2	24.4	73.9
54	11.6	10.4	21.8	60.3	12.2	11.0	23.0	67.1	12.9	11.6	24.3	74.8	13.6	12.2	25.6	83.0
56	11.9	11.4	23.1	67.8	12.6	11.8	24.4	74.3	13.3	12.7	25.9	91.1	14.0	13.4	27.2	93.8
58	12.1	12.2	24.5	73.8	12.8	13.0	26.0	83.2	13.5	13.6	27.4	91.8	14.2	14.4	28.8	102.6
60	12.4	13.4	26.4	83.1	13.0	14.2	27.6	92.3	13.9	15.0	29.6	104.2	14.6	15.8	31.0	115.3
62	13.1	15.0	28.4	98.3	14.0	15.8	30.0	110.6	14.6	16.7	31.7	121.9	15.4	17.6	33.4	135.5
64	13.9	16.8	29.5	116.7	14.8	17.8	32.8	131.7	15.6	18.8	32.9	146.6	16.4	19.8	36.6	162.4
66	14.8	19.4	35.0	143.5	15.6	20.4	37.0	159.1	16.6	21.7	39.1	180.1	17.4	22.8	41.2	198.4
68	17.0	23.6	42.0	200.6	18.0	25.0	44.4	225.0	19.0	26.5	47.0	251.7	20.0	27.8	49.4	278.0

70	------	25.1	43.6	213.3	------	26.6	46.2	239.4	------	28.1	48.8	266.9	------	29.6	51.4	296.0
72	------	26.5	49.0	225.2	------	28.2	48.2	253.8	------	29.6	54.3	281.2	------	31.2	57.8	312.0
74	------	28.2	50.3	239.7	------	29.8	50.2	268.2	------	31.5	56.2	299.2	------	33.2	59.2	332.0
76	------	30.1	51.7	255.8	------	31.8	52.0	286.2	------	33.6	57.8	319.2	------	35.4	60.8	354.0
78	------	32.0	53.0	272.0	------	33.8	54.8	304.2	------	35.2	59.5	334.4	------	37.6	62.4	376.0
80	------	34.0	54.5	289.0	------	36.0	57.8	324.0	------	38.0	61.0	361.0	------	40.0	64.0	400.0
82	------	36.3	57.2	308.5	------	38.2	60.4	343.8	------	41.5	64.0	394.2	------	42.8	67.2	428.0
84	------	38.9	60.0	330.6	------	40.6	63.2	365.4	------	43.5	67.0	413.2	------	45.8	70.4	458.0
86	------	41.4	63.0	351.9	------	43.8	67.2	394.2	------	46.3	70.5	439.8	------	48.6	74.0	486.0
88	------	44.2	66.5	375.7	------	46.2	70.4	415.8	------	49.4	74.5	469.3	------	52.0	78.2	520.0
90	------	47.4	70.2	402.9	------	50.0	74.8	450.0	------	56.0	78.8	532.0	------	55.6	82.8	556.0
92	------	50.2	75.0	426.7	------	53.8	79.4	484.2	------	56.7	84.0	538.6	------	59.6	88.0	596.0
94	------	54.8	79.0	465.8	------	57.6	84.2	518.4	------	61.1	88.5	580.4	------	64.2	93.0	642.0
96	------	58.9	84.5	500.6	------	62.0	89.6	558.0	------	65.9	94.8	626.0	------	69.2	99.6	692.0
98	------	63.2	91.0	537.2	------	67.0	96.0	603.0	------	70.8	98.0	672.6	------	74.4	106.4	744.0
100	------	68.7	97.0	583.9	------	72.6	102.8	653.4	------	76.7	108.2	728.6	------	80.6	114.0	806.0



B=distance, in feet, cut into hillside from grade stake to toe of cut slope.
C=vertical cut, in feet, to be marked on cut stake.
S=distance along slope, to be measured from grade stake to cut stake.
A=area, in square feet, of cut section.
W=width of finished road.

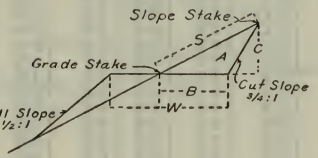
NOTE.—To obtain cubic yardage per 100 feet. multiply average end areas by 3.7.

Table XVI.—SLOPE STAKES AND AREAS—Continued

[For use on Forest Service minor roads] CUT SLOPE ¾:1

Slope, percent	Width of finished road															
	21				22				23				24			
	B	C	S	A	B	C	S	A	B	C	S	A	B	C	S	A
10	11.4	1.3	12.4	7.4	12.0	1.4	13.0	8.4	12.4	1.4	13.6	8.7	13.0	1.4	14.2	9.1
12	11.4	1.5	12.6	8.5	12.0	1.6	13.4	9.6	12.4	1.6	13.8	9.9	13.0	1.8	14.4	11.7
14	11.4	1.9	12.8	10.8	12.0	2.0	13.6	12.0	12.4	2.1	14.0	13.0	13.0	2.0	14.8	13.0
16	11.6	2.1	13.2	12.2	12.2	2.2	14.0	13.4	12.7	2.3	14.5	14.6	13.2	2.4	15.2	15.8
18	11.6	2.5	13.4	14.5	12.2	2.6	14.2	15.9	12.7	2.8	14.7	17.8	13.2	2.8	15.4	18.5
20	11.6	2.7	13.9	15.7	12.2	2.8	14.6	17.1	12.7	3.0	15.2	19.1	13.2	3.2	15.8	21.1
22	11.6	3.2	14.3	18.6	12.2	3.2	15.0	19.5	12.7	3.5	15.6	22.2	13.2	3.6	16.2	23.8
24	11.8	3.4	14.7	20.1	12.2	3.6	15.4	22.0	12.9	3.7	16.1	23.9	13.4	4.0	16.8	26.8
26	11.8	3.8	15.1	22.5	12.4	4.0	15.8	24.8	12.9	4.1	16.6	26.4	13.4	4.4	17.2	29.5
28	12.0	4.2	15.5	25.2	12.4	4.4	16.4	27.3	13.1	4.6	17.0	30.1	13.6	4.8	17.8	32.6
30	12.0	4.6	16.2	27.6	12.4	5.0	16.8	31.0	13.1	5.1	17.7	33.4	13.6	5.2	18.4	35.4
32	12.0	5.1	16.6	30.6	12.4	5.4	17.4	33.5	13.1	5.5	18.2	36.0	13.6	5.8	19.0	39.4
34	12.2	5.5	17.2	33.5	12.6	5.8	18.0	36.5	13.3	6.0	18.9	39.9	13.8	6.4	19.6	44.2
36	12.2	6.1	17.6	37.2	12.6	6.4	18.6	40.3	13.3	6.7	19.3	44.6	14.0	6.8	20.2	47.6
38	12.4	6.5	18.3	40.3	12.8	6.8	19.4	43.5	13.6	7.1	20.0	48.3	14.0	7.4	21.0	51.8
40	12.4	7.2	19.1	44.6	13.0	7.4	20.0	48.1	13.6	7.8	20.9	53.0	14.2	8.2	21.8	58.2
42	12.6	7.8	20.0	49.1	13.2	8.0	20.8	52.8	13.8	8.5	21.9	58.7	14.4	8.8	22.6	63.4
44	12.8	8.4	20.8	53.8	13.4	8.8	21.8	59.0	14.0	9.2	22.8	64.4	14.8	9.6	23.8	71.0
46	13.2	9.3	21.9	61.4	13.8	9.6	23.0	66.2	14.5	10.2	23.9	74.0	15.0	10.4	25.0	78.0
48	13.4	10.1	23.0	67.7	14.0	10.4	24.0	72.8	14.7	11.4	25.1	83.8	15.2	11.4	26.2	86.6
50	13.6	10.9	24.4	74.1	14.2	11.4	25.4	80.9	15.0	12.0	26.7	90.0	15.4	12.4	27.6	95.5
52	13.8	11.8	25.6	81.4	14.6	12.4	26.6	90.5	15.2	12.9	28.1	98.0	15.8	13.6	29.2	107.4
54	14.3	12.8	27.0	91.5	15.0	13.4	28.2	100.5	15.6	14.0	29.4	109.2	16.2	14.6	30.8	118.3
56	14.7	14.1	28.5	111.0	15.2	14.6	29.8	111.0	16.1	15.4	31.3	124.0	16.6	15.8	32.6	131.1
58	15.0	15.2	30.3	114.0	15.6	16.0	31.8	124.8	16.3	16.6	33.1	135.3	17.0	17.2	34.6	146.2
60	15.3	16.6	32.6	127.0	16.0	17.4	34.0	139.2	16.8	18.2	35.7	152.9	17.4	19.0	36.8	165.3
62	16.2	18.5	35.0	149.8	17.0	19.4	36.6	164.9	17.7	20.2	38.4	178.8	18.4	21.0	39.8	193.2
64	17.2	20.8	36.4	178.9	18.0	21.8	40.2	196.2	18.9	22.8	42.1	215.5	19.6	23.6	43.6	231.3
66	18.3	24.0	43.3	219.6	19.2	25.0	45.6	240.0	20.0	26.2	47.4	262.0	20.8	27.2	49.4	282.9
68	21.0	29.2	52.0	306.6	22.0	30.6	54.4	336.6	23.0	32.0	56.8	368.0	24.0	33.4	59.2	396.0

70	------	31.1	54.0	326.5	------	32.6	56.6	358.6	------	34.0	59.1	391.0	------	35.4	61.8	424.8
72	------	32.7	60.7	343.3	------	34.6	58.8	380.6	------	35.9	66.5	412.9	------	37.6	64.2	451.2
74	------	34.9	62.1	366.4	------	36.8	61.6	404.8	------	38.2	68.1	439.3	------	40.0	67.0	480.0
76	------	37.2	63.8	390.6	------	39.0	64.2	429.0	------	40.7	69.9	468.1	------	42.6	70.0	511.2
78	------	39.5	65.4	414.7	------	41.4	66.6	455.4	------	43.2	71.8	496.8	------	45.2	73.2	542.4
80	------	42.0	67.0	441.0	------	44.2	70.4	486.2	------	46.0	73.6	529.0	------	48.2	77.2	578.4
82	------	44.9	70.9	471.4	------	47.0	74.0	517.0	------	49.2	77.3	565.8	------	51.4	80.6	616.8
84	------	48.1	74.0	505.0	------	50.2	78.0	552.2	------	52.7	81.0	606.1	------	54.6	84.6	655.2
86	------	51.0	77.8	535.5	------	53.6	82.0	589.6	------	55.9	85.1	642.9	------	58.2	89.2	698.4
88	------	54.6	82.2	573.3	------	57.2	86.8	629.2	------	59.8	89.9	687.7	------	62.2	94.4	746.4
90	------	58.5	87.0	614.2	------	61.4	92.0	675.4	------	63.9	95.2	734.9	------	66.6	99.6	779.2
92	------	62.7	92.5	658.5	------	65.8	97.4	723.8	------	68.5	101.2	787.8	------	71.6	105.6	859.2
94	------	67.4	98.0	707.7	------	70.8	103.2	778.8	------	73.8	107.0	848.7	------	77.2	112.4	926.4
96	------	72.8	104.2	764.4	------	76.2	109.4	838.2	------	79.6	114.5	915.4	------	82.8	121.0	993.6
98	------	78.0	112.0	819.0	------	82.0	117.2	902.0	------	85.6	122.4	984.4	------	89.2	128.8	1,070.4
100	------	84.9	119.9	891.4	------	88.8	125.6	976.8	------	92.7	131.1	1,066.1	------	96.8	136.8	1,161.6



B=distance, in feet, cut into hillside from grade stake to toe of cut slope.
C=vertical cut, in feet, to be marked on cut stake.
S=distance along slope, to be measured from grade stake to cut stake.
A=area, in square feet, of cut section.
W=width of finished road.

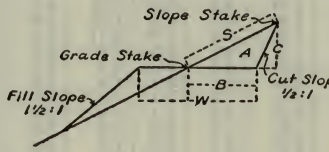
NOTE.—To obtain cubic yardage per 100 feet, multiply average end areas by 3.7.

Table XVI.—SLOPE STAKES AND AREAS—Continued

[For use on Forest Service minor roads] CUT SLOPE ½:1

Slope, %	Width of finished road															
	9				10				11				12			
	B	C	S	A	B	C	S	A	B	C	S	A	B	C	S	A
10	4.9	0.5	5.2	1.3	5.5	0.6	5.8	1.6	6.0	0.6	6.3	1.9	6.5	0.7	6.9	2.2
12	4.9	0.6	5.3	1.6	5.5	0.7	5.9	1.9	6.0	0.8	6.5	2.3	6.5	0.8	7.0	2.7
14	4.9	0.7	5.3	1.9	5.5	0.8	6.0	2.3	6.0	0.9	6.6	2.7	6.6	1.0	7.1	3.2
16	5.0	0.9	5.4	2.2	5.6	1.0	6.1	2.7	6.1	1.1	6.7	3.1	6.6	1.2	7.3	3.8
18	5.0	1.0	5.5	2.5	5.6	1.1	6.3	3.1	6.1	1.2	6.8	3.6	6.7	1.3	7.4	4.4
20	5.0	1.1	5.7	2.8	5.6	1.3	6.4	3.5	6.1	1.4	7.0	4.1	6.7	1.5	7.6	5.0
22	5.0	1.2	5.8	3.2	5.6	1.4	6.5	4.0	6.1	1.5	7.1	4.6	6.7	1.7	7.7	5.6
24	5.1	1.4	5.9	3.6	5.7	1.6	6.7	4.5	6.2	1.7	7.3	5.2	6.8	1.8	7.9	6.3
26	5.1	1.5	6.1	4.0	5.7	1.7	6.8	5.0	6.2	1.9	7.5	5.8	6.8	2.0	8.1	7.0
28	5.2	1.7	6.2	4.4	5.8	1.9	7.0	5.5	6.3	2.1	7.6	6.4	6.9	2.2	8.3	7.7
30	5.2	1.8	6.4	4.8	5.8	2.0	7.2	6.0	6.3	2.2	7.8	7.0	6.9	2.4	8.5	8.4
32	5.2	2.0	6.5	5.3	5.8	2.2	7.3	6.6	6.4	2.4	8.0	7.9	7.0	2.7	8.7	9.4
34	5.3	2.2	6.7	5.8	5.9	2.4	7.5	7.2	6.5	2.7	8.3	8.8	7.1	2.9	9.0	10.4
36	5.4	2.4	6.9	6.4	6.0	2.6	7.7	7.9	6.5	2.9	8.5	9.7	7.1	3.1	9.2	11.4
38	5.4	2.5	7.1	7.0	6.0	2.8	8.0	8.6	6.6	3.1	8.7	10.6	7.2	3.4	9.5	12.4
40	5.5	2.8	7.4	7.6	6.1	3.0	8.2	9.3	6.7	3.4	9.0	11.5	7.3	3.7	9.8	13.4
42	5.6	3.0	7.6	8.4	6.2	3.3	8.5	10.3	6.8	3.6	9.3	12.8	7.4	3.9	10.2	14.4
44	5.7	3.2	7.8	9.2	6.3	3.5	8.8	11.3	6.9	3.9	9.6	14.1	7.6	4.2	10.5	16.0
46	5.7	3.4	8.1	10.0	6.4	3.8	9.1	12.4	7.0	4.2	10.0	15.4	7.6	4.6	10.9	17.5
48	5.8	3.7	8.4	10.9	6.5	4.1	9.4	13.4	7.1	4.5	10.4	16.7	7.8	4.9	11.4	19.1
50	5.9	4.0	8.8	11.7	6.6	4.4	9.8	14.5	7.3	4.9	10.9	17.9	8.0	5.4	11.9	21.4
52	6.1	4.2	9.2	12.8	6.7	4.7	10.2	15.8	7.5	5.2	11.3	19.5	8.2	5.7	12.4	23.3
54	6.2	4.6	9.6	14.3	6.9	5.1	10.7	17.6	7.7	5.6	11.8	21.6	8.4	6.2	12.9	26.0
56	6.4	4.9	10.0	15.7	7.1	5.5	11.2	19.5	7.9	6.0	12.4	23.8	8.6	6.7	13.5	28.7
58	6.6	5.3	10.6	17.5	7.3	5.9	11.8	21.5	8.1	6.5	13.0	26.3	8.8	7.1	14.2	31.3
60	6.8	5.9	11.3	19.9	7.5	6.4	12.5	24.0	8.3	7.1	13.8	29.5	9.0	7.7	15.0	34.7
62	7.2	6.4	12.1	23.0	7.9	7.1	13.4	28.0	8.8	7.7	14.7	33.8	9.5	8.4	16.0	40.0
64	7.6	7.0	13.0	26.6	8.4	7.7	14.4	32.4	9.3	8.5	15.9	39.5	10.0	9.3	17.2	46.5
66	8.0	7.9	14.3	31.4	8.9	8.8	16.0	39.0	9.8	9.7	17.6	47.2	10.6	10.5	19.0	55.5
68	9.0	9.3	16.5	41.9	10.0	10.3	18.3	51.5	11.0	10.4	20.2	52.0	12.0	12.4	22.0	74.5
70	------	9.7	16.9	43.6	------	10.8	18.8	54.0	------	11.9	20.7	65.5	------	12.9	22.5	77.5

72	------	10.1	17.3	45.4	------	11.3	19.2	56.5	------	12.4	21.2	68.2	------	13.5	23.1	81.0
74	------	10.5	17.7	47.3	------	11.7	19.7	58.5	------	12.9	21.7	71.0	------	14.1	23.6	84.5
76	------	11.0	18.2	49.5	------	12.3	20.2	61.5	------	13.5	22.3	74.3	------	14.8	24.3	89.0
78	------	11.5	18.7	51.8	------	12.8	20.8	64.0	------	14.1	22.9	77.5	------	15.3	24.9	92.0
80	------	12.0	19.2	54.0	------	13.4	21.4	67.0	------	14.7	23.5	81.0	------	16.0	25.6	96.0
82	------	12.5	19.7	56.3	------	13.9	21.9	69.5	------	15.3	24.1	84.0	------	16.7	26.3	100.0
84	------	13.0	20.2	58.5	------	14.5	22.5	72.5	------	15.9	24.7	87.5	------	17.4	27.0	104.5
86	------	13.6	20.8	61.1	------	15.1	23.1	75.5	------	16.6	25.5	91.0	------	18.1	27.3	108.5
88	------	14.1	21.4	63.5	------	15.7	23.8	78.5	------	17.3	26.2	95.0	------	18.9	28.5	113.5
90	------	14.7	22.0	66.1	------	16.4	24.5	82.0	------	18.0	26.9	99.0	------	19.7	29.3	119.0
92	------	15.3	22.6	69.0	------	17.0	25.1	85.0	------	18.7	27.7	103.0	------	20.4	30.2	122.5
94	------	16.0	23.3	72.0	------	17.7	25.8	88.5	------	19.5	28.5	107.0	------	21.2	31.0	127.0
96	------	16.6	23.9	75.0	------	18.4	26.6	92.0	------	20.3	29.3	111.5	------	22.1	31.9	132.5
98	------	17.3	24.7	78.0	------	19.2	27.4	96.0	------	21.1	30.2	116.0	------	23.1	32.9	138.5
100	------	18.0	25.4	81.0	------	20.0	28.3	100.0	------	22.0	31.1	121.0	------	24.0	33.9	144.0



B=distance, in feet, cut into hillside from grade stake to toe of cut slope.
C=vertical cut, in feet, to be marked on cut stake.
S=distance along slope, to be measured from grade stake to cut stake.
A=area, in square feet, of cut section.
W=width of finished road.

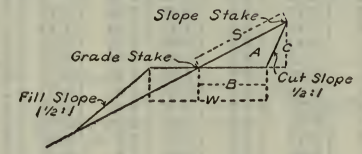
NOTE.—To obtain cubic yardage per 100 feet, multiply average end areas by 3.7.

Table XVI.—SLOPE STAKES AND AREAS—Continued

[For use on Forest Service minor roads] CUT SLOPE ½:1

Slope, %	Width of finished road															
	13				14				15				16			
	B	C	S	A	B	C	S	A	B	C	S	A	B	C	S	A
10	7.0	0.7	7.4	2.6	7.5	0.8	8.0	3.0	8.0	0.9	8.6	3.4	8.6	0.9	9.1	3.9
12	7.0	0.9	7.6	3.2	7.5	1.0	8.1	3.7	8.1	1.0	8.7	4.3	8.6	1.1	9.3	4.8
14	7.1	1.1	7.7	3.8	7.6	1.1	8.3	4.4	8.2	1.2	8.9	5.2	8.7	1.3	9.4	5.7
16	7.1	1.2	7.8	4.4	7.6	1.3	8.4	5.1	8.2	1.4	9.0	6.1	8.7	1.5	9.6	6.7
18	7.2	1.4	8.0	5.1	7.7	1.5	8.6	5.8	8.3	1.6	9.2	7.0	8.8	1.7	9.8	7.7
20	7.2	1.6	8.2	5.8	7.7	1.7	8.7	6.6	8.3	1.9	9.4	7.9	8.8	2.0	10.0	8.7
22	7.3	1.8	8.3	6.6	7.7	1.9	8.9	7.5	8.4	2.1	9.6	8.9	8.9	2.2	10.2	9.8
24	7.3	2.0	8.5	7.4	7.8	2.1	9.1	8.4	8.5	2.3	9.8	9.9	8.9	2.4	10.4	11.0
26	7.4	2.2	8.7	8.2	7.8	2.5	9.3	9.3	8.5	2.5	10.0	11.0	9.0	2.7	10.6	12.2
28	7.4	2.4	8.9	9.0	7.9	2.6	9.6	10.3	8.6	2.8	10.3	12.2	9.0	2.9	10.9	13.4
30	7.5	2.7	9.2	9.9	8.0	2.8	9.8	11.3	8.6	3.1	10.6	13.2	9.1	3.2	11.2	14.6
32	7.6	2.9	9.4	11.0	8.1	3.1	10.1	12.6	8.7	3.3	10.8	14.7	9.2	3.5	11.5	16.2
34	7.7	3.1	9.7	12.1	8.2	3.3	10.4	13.9	8.8	3.6	11.1	16.2	9.3	3.8	11.8	17.9
36	7.7	3.4	9.9	13.2	8.3	3.6	10.7	15.3	8.9	3.9	11.5	17.7	9.4	4.1	12.1	19.6
38	7.8	3.7	10.2	14.4	8.4	3.9	11.0	16.7	9.0	4.2	11.8	19.2	9.5	4.5	12.5	21.3
40	7.9	4.0	10.6	15.6	8.5	4.3	11.4	18.1	9.1	4.6	12.2	20.7	9.6	4.8	12.9	23.0
42	8.0	4.2	10.9	16.8	8.6	4.5	11.7	19.3	9.2	4.9	12.6	22.5	9.8	5.2	13.4	25.5
44	8.2	4.6	11.3	18.9	8.8	4.9	12.2	21.5	9.4	5.3	13.1	25.0	10.0	5.6	13.9	28.0
46	8.3	4.9	11.8	20.3	8.9	5.3	12.7	23.6	9.6	5.7	13.6	27.3	10.2	6.0	14.0	31.0
48	8.5	5.3	12.2	22.5	9.1	5.7	13.2	26.0	9.8	6.2	14.2	30.4	10.4	6.5	15.0	33.8
50	8.6	5.8	12.8	24.8	9.3	6.2	13.9	28.8	10.0	6.7	14.9	33.4	10.6	7.1	15.8	37.5
52	8.8	6.2	13.3	27.3	9.5	6.6	14.4	31.3	10.2	7.2	15.5	36.2	10.8	7.6	16.4	41.0
54	9.0	6.6	13.9	29.6	9.7	7.1	15.0	34.5	10.4	7.7	16.1	40.0	11.0	8.1	17.1	44.5
56	9.2	7.1	14.5	32.7	9.9	7.7	15.7	38.1	10.6	8.2	16.8	43.4	11.3	8.7	17.8	49.1
58	9.4	7.7	15.3	36.3	10.2	8.3	16.5	42.3	10.9	8.9	17.7	48.5	11.6	9.3	18.7	54.0
60	9.7	8.3	16.2	40.3	10.5	9.0	17.5	47.2	11.2	9.6	18.7	53.8	11.9	10.2	19.8	60.7
62	10.3	9.1	17.2	47.0	11.1	9.8	18.6	54.5	11.9	10.5	19.9	62.5	12.6	11.2	21.0	70.5
64	10.9	10.0	18.5	54.5	11.7	10.8	20.0	63.3	12.6	11.5	21.4	72.5	13.3	12.3	22.7	81.8
66	11.4	11.2	20.4	64.0	12.4	12.2	22.2	76.0	13.3	13.1	23.8	87.0	14.1	13.9	25.2	98.0
68	13.0	13.4	23.8	87.0	14.0	14.5	25.7	101.5	15.0	15.3	27.5	115.0	16.0	16.5	29.4	132.0
70	------	14.0	24.4	91.0	------	15.1	26.3	105.5	------	16.2	28.2	121.5	------	17.3	30.1	138.0

72	------	14.6	25.0	96.0	------	15.7	26.9	110.0	------	16.9	28.9	127.0	------	18.0	30.8	144.0
74	------	15.2	25.6	99.0	------	16.4	27.6	115.0	------	17.6	29.6	132.0	------	18.8	31.6	150.0
76	------	15.9	26.3	103.5	------	17.1	28.3	119.5	------	18.4	30.3	138.0	------	19.6	32.4	156.5
78	------	16.6	27.0	108.0	------	17.9	29.1	125.0	------	19.2	31.2	144.0	------	20.5	33.3	162.4
80	------	17.3	27.7	112.5	------	18.7	29.9	131.0	------	20.0	32.0	150.0	------	21.4	34.2	171.0
82	------	18.1	28.5	117.5	------	19.5	30.7	136.5	------	20.9	32.9	157.0	------	22.3	35.1	178.0
84	------	18.8	29.2	122.0	------	20.2	31.5	141.5	------	21.7	33.7	163.0	------	23.2	36.0	185.5
86	------	19.6	30.0	127.5	------	21.1	32.3	147.5	------	22.6	34.7	169.5	------	24.2	37.0	193.5
88	------	20.4	30.9	132.5	------	22.0	33.3	154.0	------	23.6	35.7	177.0	------	25.2	38.0	201.5
90	------	21.3	31.8	138.5	------	22.9	34.2	160.0	------	24.6	36.7	184.5	------	26.2	39.2	210.0
92	------	22.1	32.6	143.5	------	23.8	35.2	166.5	------	25.6	37.7	192.0	------	27.2	40.2	217.5
94	------	23.0	33.6	149.5	------	24.8	36.2	173.5	------	26.6	38.8	199.5	------	28.3	41.4	226.0
96	------	23.9	34.6	155.5	------	25.8	37.2	180.5	------	27.7	39.9	207.5	------	29.5	42.5	236.0
98	------	25.0	35.6	162.5	------	26.9	38.4	188.0	------	28.8	41.1	216.0	------	30.7	43.9	246.0
100	------	26.0	36.8	169.0	------	28.0	39.6	196.0	------	30.0	42.4	225.0	------	32.0	45.3	256.0



B = distance in, feet, cut into hillside from grade stake to toe of cut slope.
C = vertical cut, in feet, to be marked on cut stake.
S = distance along slope, to be measured from grade stake to cut stake.
A = area, in square feet, of cut section.
W = width of finished road.

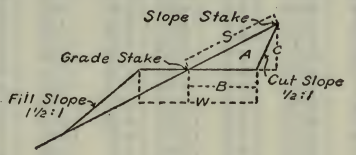
NOTE.—To obtain cubic yardage per 100 feet, multiply average end areas by 3.7.

Table XVI.—SLOPE STAKES AND AREAS—Continued

[For use on Forest Service minor roads] CUT SLOPE 1/2 : 1

Slope %	Width of finished road															
	17				18				19				20			
	B	C	S	A	B	C	S	A	B	C	S	A	B	C	S	A
10	9.4	1.0	9.8	4.7	9.8	1.0	10.4	4.9	10.4	1.0	11.0	5.2	11.0	1.2	11.6	6.6
12	9.4	1.2	10.0	5.6	9.8	1.2	10.6	5.9	10.4	1.3	11.2	6.8	11.0	1.4	11.8	7.7
14	9.4	1.4	10.2	6.6	9.8	1.4	10.6	6.9	10.4	1.5	11.4	7.8	11.0	1.6	12.0	8.8
16	9.5	1.7	10.4	8.1	10.0	1.8	10.8	9.0	10.6	1.9	11.6	10.1	11.2	2.0	12.2	11.2
18	9.5	1.9	10.7	9.0	10.0	2.0	11.0	10.0	10.6	2.1	12.0	11.1	11.2	2.2	12.6	12.3
20	9.5	2.2	10.9	10.4	10.0	2.2	11.4	11.0	10.6	2.5	12.2	13.2	11.2	2.6	12.8	14.6
22	9.5	2.4	11.0	11.4	10.0	2.4	11.6	12.0	10.6	2.7	12.4	14.3	11.2	2.8	13.0	15.7
24	9.7	2.7	11.4	13.1	10.2	2.8	11.8	14.3	10.8	3.0	12.7	16.2	11.4	3.2	13.4	18.2
26	9.7	2.9	11.6	14.1	10.2	3.0	12.2	15.3	10.8	3.2	12.9	17.3	11.4	3.4	13.6	19.4
28	9.9	3.2	11.9	15.8	10.4	3.4	12.4	17.7	11.0	3.6	13.3	19.8	11.6	3.8	14.0	22.0
30	9.9	3.4	12.2	16.8	10.4	3.6	12.8	18.7	11.0	3.8	13.7	20.9	11.6	4.0	14.4	23.2
32	9.9	3.7	12.4	18.3	10.4	4.0	13.0	20.8	11.0	4.2	13.8	23.1	11.6	4.4	14.6	25.5
34	10.0	4.1	12.7	20.5	10.6	4.4	13.4	23.3	11.2	4.6	14.2	25.8	11.8	4.8	15.0	28.3
36	10.2	4.4	13.1	22.4	10.8	4.8	13.8	25.9	11.4	4.9	14.6	27.9	12.0	5.2	15.4	31.2
38	10.2	4.8	13.6	24.5	10.8	5.0	14.2	27.0	11.4	5.1	15.2	29.1	12.0	5.6	16.0	33.6
40	10.4	5.1	13.9	26.5	11.0	5.6	14.8	30.8	11.6	5.7	15.6	32.5	12.2	6.0	16.4	36.6
42	10.6	5.6	14.4	29.7	11.2	6.0	15.2	33.6	11.8	6.3	16.2	36.1	12.4	6.6	17.0	40.9
44	10.7	5.9	15.0	31.6	11.4	6.4	15.6	36.5	12.0	6.6	16.8	39.6	12.6	7.0	17.6	44.1
46	10.9	6.5	15.4	35.4	11.4	6.8	16.2	38.8	12.2	7.2	17.3	43.9	12.8	7.6	18.2	48.6
48	11.0	7.0	16.0	38.5	11.6	7.4	16.8	42.9	12.4	7.8	17.9	48.4	13.0	8.2	18.8	53.3
50	11.2	7.5	16.6	42.0	11.8	8.0	17.6	47.2	12.6	8.3	18.6	52.3	13.2	8.8	19.6	58.1
52	11.4	8.0	17.4	45.6	12.2	8.4	18.4	51.2	12.7	8.9	19.4	56.5	13.4	9.4	20.4	63.0
54	11.7	8.7	18.2	50.9	12.4	9.2	19.2	57.0	13.1	9.7	20.4	63.5	13.8	10.2	21.4	70.4
56	12.1	9.4	19.0	56.9	12.8	9.8	20.0	62.7	13.5	10.4	21.3	70.2	14.2	11.0	22.4	78.1
58	12.4	10.0	20.0	62.0	13.2	10.6	21.2	70.0	13.9	11.2	22.5	77.8	14.6	11.8	23.6	86.1
60	12.8	10.9	21.2	69.8	13.6	11.8	22.6	80.2	14.3	12.2	23.7	87.2	15.0	12.8	25.0	96.0
62	13.4	12.1	22.8	81.1	14.4	12.8	24.2	92.2	15.0	13.5	25.5	101.3	15.8	14.2	26.8	112.2
64	14.3	13.1	24.5	93.7	15.2	14.0	26.0	106.4	16.0	14.6	27.4	116.8	16.8	15.4	28.8	129.4
66	15.2	15.0	27.2	114.0	16.0	15.8	28.6	126.4	16.9	16.8	30.5	142.0	17.8	17.6	32.0	156.6
68	17.0	17.5	29.5	148.7	18.0	18.6	33.0	167.4	19.0	19.6	32.9	186.2	20.0	20.6	36.6	206.0

70	------	18.4	32.0	156.4	------	19.4	33.8	174.6	------	20.5	35.7	194.7	------	21.6	37.6	216.0
72	------	19.2	32.6	163.2	------	20.2	34.6	181.8	------	21.5	36.5	204.2	------	22.6	38.4	226.0
74	------	19.9	33.5	169.1	------	21.0	35.4	189.0	------	22.2	37.5	210.9	------	23.4	39.4	234.0
76	------	20.9	34.4	177.6	------	22.0	36.4	198.0	------	23.4	38.5	222.3	------	24.6	40.4	246.0
78	------	21.7	35.4	184.4	------	23.0	37.4	207.0	------	24.3	39.5	230.8	------	25.6	41.6	256.0
80	------	22.8	36.4	193.8	------	24.0	38.4	216.0	------	25.5	40.6	242.2	------	26.8	42.8	268.0
82	------	23.5	37.1	199.7	------	25.0	39.4	225.0	------	26.4	41.6	250.8	------	27.8	43.8	278.0
84	------	24.6	38.4	209.1	------	26.0	40.4	234.0	------	27.5	42.8	261.3	------	29.0	45.0	290.0
86	------	25.7	39.3	218.4	------	27.2	41.6	244.8	------	28.6	44.0	271.7	------	30.2	46.2	302.0
88	------	26.6	40.5	226.1	------	28.2	42.8	253.8	------	29.8	45.3	283.1	------	31.4	47.6	314.0
90	------	27.8	41.6	236.3	------	29.4	44.0	264.6	------	31.1	46.5	295.4	------	32.8	49.0	328.0
92	------	28.9	42.9	245.6	------	30.6	45.2	276.3	------	32.3	47.8	306.8	------	34.0	50.2	340.0
94	------	30.0	44.0	255.0	------	32.0	46.6	288.0	------	33.5	49.2	318.2	------	35.4	51.6	354.0
96	------	31.4	45.3	266.9	------	33.2	47.8	298.8	------	35.0	50.7	332.5	------	36.8	53.2	368.0
98	------	32.7	46.6	277.9	------	34.6	49.4	311.4	------	36.5	52.0	346.7	------	38.4	54.8	384.0
100	------	34.0	48.2	289.0	------	36.0	50.8	324.0	------	38.0	54.0	361.0	------	40.0	56.6	400.0



B=distance, in feet, cut into hillside from grade stake to toe of cut slope.
C=vertical cut, in feet, to be marked on cut stake.
S=distance along slope, to be measured from grade stake to cut stake.
A=area, in square feet, of cut section.
W=width of finished road.

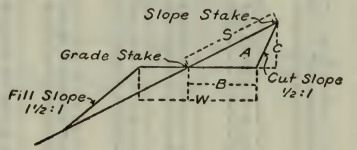
NOTE.—To obtain cubic yardage per 100 feet, multiply average end areas by 3.7.

Table XVI.—SLOPE STAKES AND AREAS—Continued

[For use on Forest Service minor roads] CUT SLOPE 1/2 : 1

Slope %	Width of finished road															
	21				22				23				24			
	B	C	S	A	B	C	S	A	B	C	S	A	B	C	S	A
10	11.6	1.3	12.2	7.5	12.0	1.2	12.6	7.2	12.7	1.4	13.3	8.9	13.0	1.4	13.8	9.1
12	11.6	1.5	12.4	8.7	12.0	1.6	13.0	9.6	12.7	1.6	13.6	10.2	13.0	1.6	14.0	10.4
14	11.6	1.7	12.6	9.9	12.0	1.8	13.2	10.8	12.7	1.8	13.8	11.4	13.2	2.0	14.2	13.2
16	11.8	2.1	12.8	12.4	12.2	2.2	13.4	13.4	12.9	2.3	14.0	14.8	13.2	2.4	14.6	15.8
18	11.8	2.3	13.2	13.6	12.2	2.4	13.6	14.6	12.9	2.5	14.5	16.1	13.4	2.6	14.8	17.4
20	11.8	2.7	13.4	15.9	12.2	2.8	14.0	17.1	12.9	3.0	14.7	19.4	13.4	3.0	15.2	20.1
22	11.8	2.9	13.6	17.1	12.2	3.0	14.2	18.3	12.9	3.2	15.0	20.6	13.4	3.4	15.4	22.8
24	12.0	3.4	14.1	20.4	12.4	3.4	14.6	21.1	13.1	3.7	15.4	24.2	13.6	3.6	15.8	24.5
26	12.0	3.6	14.3	21.6	12.4	3.8	15.0	23.6	13.1	3.9	15.6	25.5	13.6	4.0	16.2	27.2
28	12.2	4.0	14.7	24.4	12.6	4.2	15.2	26.5	13.3	4.4	16.1	29.3	13.8	4.4	16.6	30.4
30	12.2	4.2	15.1	25.6	12.6	4.4	15.6	27.7	13.3	4.6	16.6	30.6	13.8	4.8	17.0	33.1
32	12.2	4.6	15.4	28.1	12.8	4.8	16.0	30.7	13.3	5.1	16.8	33.9	14.0	5.4	17.4	37.8
34	12.4	5.0	15.8	31.0	13.0	5.4	16.6	35.1	13.6	5.5	17.3	37.4	14.2	5.8	18.0	41.2
36	12.6	5.5	16.2	34.6	13.0	5.8	17.0	37.7	13.8	6.0	17.7	41.4	14.2	6.2	18.4	44.0
38	12.6	5.8	16.8	36.5	13.2	6.2	17.4	40.9	13.8	6.4	18.4	44.2	14.4	6.8	19.0	49.0
40	12.8	6.3	17.2	40.3	13.4	6.8	18.0	45.6	14.0	6.9	18.9	48.3	14.6	7.4	19.6	54.0
42	13.0	6.9	17.8	44.8	13.6	7.2	18.6	49.0	14.3	7.6	19.6	54.3	14.8	7.8	20.4	57.7
44	13.2	7.4	18.5	48.8	13.8	7.8	19.2	53.8	14.5	8.1	20.2	58.7	15.2	8.4	21.0	63.8
46	13.4	8.0	19.1	53.6	14.0	8.4	20.0	58.8	14.7	8.7	20.9	63.9	15.2	9.2	21.8	69.9
48	13.6	8.6	19.7	58.5	14.2	9.0	20.8	63.9	15.0	9.4	21.6	70.5	15.6	9.8	22.8	76.4
50	13.8	9.3	20.6	64.2	14.6	9.8	21.8	71.5	15.2	10.1	22.5	76.8	16.0	10.8	23.8	86.4
52	14.1	9.8	21.5	69.1	15.0	10.4	22.6	78.0	15.4	10.8	23.5	83.2	16.4	11.4	24.8	93.5
54	14.4	10.7	22.5	77.0	15.4	11.2	23.6	86.2	15.9	11.7	24.6	93.0	16.8	12.4	25.8	104.2
56	14.9	11.5	23.5	85.7	15.8	12.0	24.8	94.8	16.3	12.7	25.8	109.9	17.2	13.4	27.0	115.2
58	15.3	12.4	24.8	94.9	16.2	13.0	26.0	105.3	16.8	13.6	27.1	114.2	17.6	14.2	28.4	125.0
60	15.8	13.4	26.2	105.9	16.6	14.2	27.6	117.9	17.3	14.7	28.8	127.2	18.0	15.4	30.0	138.6
62	16.6	14.9	28.1	123.7	17.6	15.4	29.4	135.5	18.2	16.3	30.8	148.3	19.0	16.8	32.0	159.6
64	17.7	16.2	30.3	143.4	18.6	17.0	31.8	158.1	19.3	17.7	33.1	170.8	20.0	18.6	34.4	186.0
66	18.7	18.5	33.6	173.0	19.6	19.4	35.2	190.1	20.5	20.2	36.8	207.1	21.2	21.0	38.0	222.6
68	21.0	21.6	36.4	226.8	22.0	20.8	40.4	220.8	23.0	23.7	42.1	272.6	24.0	24.8	44.0	297.6

70	------	22.7	39.5	238.3	------	23.8	41.4	261.8	------	24.8	43.2	285.2	------	25.8	45.0	309.6
72	------	23.6	40.5	247.8	------	24.8	42.4	272.8	------	26.0	44.1	299.0	------	27.0	46.2	324.0
74	------	24.6	41.5	258.3	------	25.8	43.4	283.8	------	26.9	45.8	309.4	------	28.2	47.2	338.4
76	------	25.8	42.5	270.9	------	27.0	44.6	297.0	------	28.3	46.5	325.5	------	29.6	48.6	355.2
78	------	26.9	43.8	282.4	------	28.2	45.8	310.2	------	29.4	47.8	338.1	------	30.6	49.8	367.2
80	------	28.1	44.9	295.1	------	29.4	47.0	323.4	------	30.8	49.2	354.2	------	32.0	51.2	384.0
82	------	29.1	46.0	305.5	------	30.6	48.2	336.6	------	32.0	50.4	368.0	------	33.4	52.6	400.8
84	------	30.5	47.3	320.2	------	31.8	49.4	349.8	------	33.4	51.8	384.1	------	34.8	54.0	417.6
86	------	31.7	48.5	332.8	------	33.2	51.0	365.2	------	34.7	53.1	399.1	------	36.2	54.6	434.4
88	------	33.0	50.0	346.5	------	34.6	52.4	380.6	------	36.1	54.7	415.2	------	37.8	57.0	453.6
90	------	34.4	51.2	361.2	------	36.0	53.8	396.0	------	37.7	56.4	433.6	------	39.4	58.6	472.8
92	------	35.7	53.0	374.8	------	37.4	55.4	411.4	------	39.1	57.7	449.7	------	40.8	60.4	489.6
94	------	37.1	54.1	389.5	------	39.0	57.0	429.0	------	40.7	59.3	468.1	------	42.4	62.0	504.0
96	------	38.6	56.0	405.3	------	40.6	58.6	446.6	------	42.3	61.2	486.5	------	44.2	63.8	530.4
98	------	40.4	57.3	424.2	------	42.2	60.4	464.2	------	44.2	63.0	508.3	------	46.2	65.8	554.4
100	------	42.0	59.5	441.0	------	44.0	62.2	484.0	------	46.0	65.1	529.0	------	48.0	67.8	576.0



B = distance, in feet, cut into hillside from grade stake to toe of cut slope.
C = vertical cut, in feet, to be marked on cut stake.
S = distance along slope, to be measured from grade stake to cut stake.
A = area, in square feet, of cut section.
W = width of finished road.

NOTE.—To obtain cubic yardage per 100 feet, multiply average end areas by 3.7.

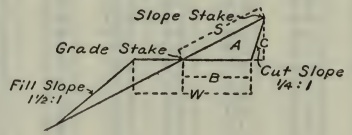
Table XVI.—SLOPE STAKES AND AREAS—Continued

[For use on Forest Service minor roads]

CUT SLOPE ¼:1

Slope, %	Width of finished road															
	9				10				11				12			
	B	C	S	A	B	C	S	A	B	C	S	A	B	C	S	A
10	4.8	0.5	5.0	1.2	5.3	0.5	5.5	1.5	5.9	0.6	6.1	1.8	6.4	0.7	6.7	2.1
12	4.8	0.6	5.0	1.4	5.3	0.7	5.5	1.8	5.9	0.7	6.2	2.2	6.4	0.8	6.7	2.6
14	4.9	0.7	5.1	1.7	5.4	0.8	5.6	2.1	6.0	0.9	6.2	2.6	6.5	1.0	6.8	3.1
16	4.9	0.8	5.2	2.0	5.4	0.9	5.7	2.5	6.0	1.0	6.3	3.0	6.5	1.1	7.0	3.6
18	5.0	1.0	5.3	2.3	5.5	1.0	5.8	2.9	6.1	1.2	6.4	3.4	6.6	1.3	7.1	4.1
20	5.0	1.0	5.4	2.6	5.5	1.2	5.9	3.3	6.1	1.3	6.6	3.9	6.7	1.4	7.2	4.7
22	5.0	1.2	5.5	2.9	5.5	1.3	6.0	3.7	6.1	1.4	6.7	4.4	6.7	1.6	7.3	5.3
24	5.1	1.3	5.6	3.3	5.6	1.4	6.1	4.1	6.2	1.6	6.8	4.9	6.8	1.8	7.5	5.9
26	5.1	1.4	5.7	3.7	5.6	1.6	6.3	4.5	6.2	1.8	6.9	5.5	6.8	1.9	7.6	6.5
28	5.2	1.6	5.8	4.1	5.7	1.7	6.4	5.0	6.3	1.9	7.1	6.1	6.9	2.1	7.7	7.2
30	5.3	1.7	6.0	4.5	5.8	1.9	6.5	5.5	6.4	2.1	7.2	6.7	7.0	2.3	7.9	7.9
32	5.4	1.9	6.1	5.0	5.8	2.0	6.7	6.0	6.4	2.3	7.4	7.4	7.1	2.5	8.1	8.7
34	5.4	2.0	6.2	5.5	5.9	2.2	6.8	6.5	6.5	2.4	7.6	8.1	7.2	2.7	8.2	9.5
36	5.5	2.2	6.4	6.0	5.9	2.4	7.0	7.1	6.6	2.6	7.7	8.8	7.2	2.9	8.4	10.4
38	5.5	2.3	6.5	6.5	6.0	2.5	7.1	7.7	6.7	2.8	7.9	9.5	7.3	3.1	8.6	11.3
40	5.6	2.5	6.7	7.0	6.1	2.7	7.3	8.3	6.8	3.0	8.1	10.2	7.4	3.3	8.9	12.2
42	5.7	2.7	6.8	7.6	6.2	2.9	7.5	9.0	6.9	3.2	8.3	11.0	7.5	3.5	9.1	13.1
44	5.7	2.8	7.0	8.2	6.3	3.1	7.7	9.7	7.0	3.4	8.5	11.9	7.6	3.8	9.4	14.4
46	5.8	3.0	7.2	8.8	6.4	3.3	7.9	10.8	7.1	3.7	8.8	13.1	7.7	4.0	9.6	15.4
48	5.9	3.2	7.4	9.5	6.5	3.5	8.2	11.3	7.2	3.9	9.0	14.1	7.8	4.3	9.9	16.8
50	6.0	3.4	7.7	10.2	6.6	3.8	8.5	12.6	7.3	4.2	9.3	15.3	8.0	4.6	10.2	18.4
52	6.1	3.6	7.9	11.0	6.7	4.0	8.7	13.4	7.5	4.5	9.7	16.9	8.2	4.9	10.5	20.1
54	6.3	3.9	8.2	12.3	6.9	4.3	9.1	14.8	7.7	4.8	10.0	18.5	8.4	5.2	10.9	21.8
56	6.4	4.2	8.5	13.5	7.1	4.6	9.4	16.3	7.9	5.1	10.4	20.1	8.6	5.6	11.3	24.1
58	6.6	4.5	8.9	14.8	7.3	4.9	9.8	17.8	8.1	5.4	10.8	21.4	8.8	5.9	11.8	26.0
60	6.8	4.8	9.3	16.3	7.5	5.3	10.3	19.9	8.3	5.9	11.3	24.4	9.0	6.4	12.4	28.8
62	7.2	5.2	9.9	18.2	7.9	5.8	10.9	23.3	8.8	6.3	12.0	27.8	9.5	6.9	13.1	32.8
64	7.6	5.7	10.5	20.7	8.4	6.3	11.6	26.5	9.3	6.9	12.8	32.1	10.1	7.5	14.0	38.4
66	8.0	6.3	11.5	25.2	8.9	7.0	12.8	31.1	9.8	7.8	14.0	38.2	10.7	8.5	15.4	45.4
68	9.0	7.4	13.1	33.3	10.0	8.2	14.6	41.0	11.0	9.0	16.0	49.5	12.0	9.8	17.5	54.0
70	------	7.6	13.3	34.2	------	8.5	14.8	42.5	------	9.3	16.3	51.5	------	10.2	17.7	61.3

72	7.9	13.5	35.6	8.8	15.0	44.0	9.8	16.5	54.0	10.5	18.0	63.0
74	8.2	13.7	36.9	9.1	15.2	45.5	10.0	16.8	55.0	10.9	18.3	65.5
76	8.4	14.0	37.6	9.4	15.5	47.0	10.3	17.0	56.5	11.2	18.6	67.0
78	8.7	14.2	39.2	9.7	15.8	48.5	10.7	17.3	59.0	11.6	18.9	69.5
80	9.0	14.4	40.5	10.0	16.0	50.0	11.0	17.6	60.5	12.0	19.2	72.0
82	9.3	14.7	41.9	10.3	16.3	51.5	11.3	17.9	62.0	12.4	19.5	74.5
84	9.6	14.9	43.2	10.6	16.5	53.0	11.7	18.2	64.5	12.7	19.8	76.3
86	9.9	15.1	44.5	11.0	16.8	55.0	12.1	18.5	66.5	13.1	20.1	78.5
88	10.2	15.4	45.9	11.3	17.1	56.5	12.4	18.8	68.3	13.5	20.5	81.0
90	10.5	15.6	47.3	11.6	17.4	58.0	12.8	19.1	70.5	13.9	20.8	83.5
92	10.8	15.9	48.5	12.0	17.6	60.0	13.1	19.4	72.0	14.3	21.1	86.0
94	11.1	16.1	49.9	12.3	17.9	61.5	13.5	19.7	74.3	14.7	21.5	88.0
96	11.4	16.4	51.3	12.6	18.2	63.0	13.9	20.0	76.5	15.1	21.8	90.5
98	11.7	16.8	52.6	13.0	18.5	65.0	14.3	20.4	78.5	15.6	22.2	93.5
100	12.0	17.0	54.0	13.4	18.9	67.0	14.8	20.8	81.5	16.0	22.7	96.0



B=distance, in feet, cut into hillside from grade stake to toe of cut slope.
C=vertical cut, in feet, to be marked on cut stake.
S=distance along slope, to be measured from grade stake to cut stake.
A=area, in square feet, of cut section.
W=width of finished road.

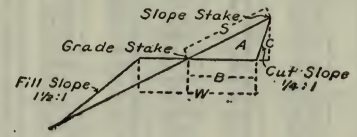
NOTE.—To obtain cubic yardage per 100 feet, multiply average end areas by 3.7.

Table XVI.—SLOPE STAKES AND AREAS—Continued

[For use on Forest Service minor roads] CUT SLOPE ¼:1

Slope, %	Width of finished road															
	13				14				15				16			
	B	C	S	A	B	C	S	A	B	C	S	A	B	C	S	A
10	7.0	0.7	7.2	4.9	7.5	0.8	7.7	2.8	8.0	0.8	8.2	3.2	8.5	0.9	8.8	3.8
12	7.0	0.9	7.3	5.0	7.5	1.0	7.8	3.5	8.0	1.0	8.4	4.0	8.5	1.1	8.9	4.7
14	7.1	1.0	7.4	5.1	7.6	1.1	8.0	4.2	8.1	1.2	8.5	4.8	8.6	1.3	9.0	5.6
16	7.1	1.2	7.5	5.2	7.6	1.2	8.1	4.9	8.1	1.4	8.6	5.7	8.6	1.5	9.2	6.5
18	7.2	1.4	7.7	5.3	7.7	1.5	8.2	5.6	8.2	1.6	8.8	6.5	8.7	1.7	9.3	7.4
20	7.3	1.5	7.8	5.5	7.8	1.7	8.4	6.4	8.3	1.8	8.9	7.4	8.8	1.9	9.5	8.3
22	7.3	1.7	7.9	6.2	7.8	1.8	8.5	7.3	8.3	2.0	9.1	8.2	8.9	2.1	9.7	9.4
24	7.4	1.9	8.1	6.9	7.9	2.0	8.7	8.2	8.4	2.2	9.2	9.2	9.0	2.3	9.8	10.5
26	7.4	2.1	8.2	7.7	8.0	2.2	8.8	9.1	8.5	2.4	9.4	10.2	9.1	2.5	10.0	11.6
28	7.5	2.3	8.4	8.5	8.1	2.4	9.0	10.1	8.6	2.6	9.6	11.2	9.2	2.8	10.2	12.8
30	7.6	2.5	8.6	9.3	8.2	2.7	9.2	11.1	8.7	2.8	9.8	12.2	9.3	3.0	10.4	14.0
32	7.7	2.7	8.8	10.2	8.2	2.9	9.4	11.9	8.8	3.1	10.0	13.5	9.4	3.3	10.7	15.5
34	7.8	2.9	9.0	11.2	8.3	3.1	9.6	12.9	8.9	3.3	10.2	14.8	9.5	3.5	10.9	16.6
36	7.8	3.1	9.2	12.3	8.4	3.3	9.8	13.9	9.0	3.6	10.5	16.2	9.6	3.8	11.1	18.3
38	7.9	3.3	9.4	13.4	8.5	3.6	10.0	15.3	9.1	3.8	10.7	17.5	9.7	4.1	11.4	19.9
40	8.0	3.6	9.6	14.4	8.6	3.8	10.3	16.4	9.2	4.1	11.0	18.9	9.8	4.4	11.7	21.6
42	8.1	3.8	9.8	15.4	8.7	4.1	10.5	17.5	9.3	4.4	11.3	20.5	9.9	4.7	12.0	23.3
44	8.2	4.1	10.1	16.8	8.9	4.4	10.8	19.6	9.5	4.7	11.6	22.3	10.1	5.0	12.4	25.3
46	8.3	4.3	10.3	17.9	9.0	4.7	11.1	21.2	9.6	5.0	12.0	24.0	10.2	5.3	12.7	27.0
48	8.4	4.6	10.6	19.3	9.2	5.0	11.5	23.0	9.8	5.3	12.4	26.0	10.4	5.7	13.1	29.6
50	8.6	5.0	11.0	21.6	9.3	5.3	11.9	24.6	10.0	5.7	12.8	28.5	10.6	6.1	13.5	32.3
52	8.8	5.2	11.3	22.9	9.5	5.7	12.3	27.1	10.2	6.1	13.2	31.1	10.8	6.5	14.0	35.1
54	9.0	5.6	11.8	25.2	9.8	6.0	12.7	29.4	10.4	6.5	13.7	33.8	11.0	6.9	14.5	37.9
56	9.2	6.0	12.2	27.6	10.0	6.4	13.2	32.0	10.7	6.9	14.2	36.9	11.3	7.3	15.0	41.3
58	9.4	6.4	12.8	30.1	10.3	6.9	13.7	35.5	11.0	7.4	14.8	40.7	11.6	7.8	15.6	45.3
60	9.7	6.9	13.3	33.5	10.5	7.4	14.4	38.8	11.3	8.0	15.5	45.2	11.9	8.6	16.4	50.0
62	10.3	7.4	14.0	38.1	11.1	8.1	15.3	45.0	11.9	8.6	16.4	51.0	12.6	9.1	17.2	57.5
64	10.9	8.1	15.0	44.1	11.8	8.7	16.3	51.0	12.6	9.4	17.5	59.3	13.3	9.9	18.5	66.0
66	11.6	9.2	16.7	53.5	12.5	9.9	18.0	62.0	13.3	10.5	19.1	70.0	14.1	11.1	20.2	78.5
68	13.0	10.7	18.9	69.5	14.0	11.4	20.2	80.0	15.0	12.3	21.9	92.0	16.0	13.1	23.3	104.0
70	------	11.0	19.2	71.5	------	11.9	20.7	83.5	------	12.7	22.2	94.5	------	13.6	23.7	109.0

72	11.4	19.5	74.0	12.3	21.0	86.0	13.2	22.5	99.0	13.0	24.0	112.0
74	11.8	19.8	76.5	12.7	21.4	89.0	13.6	22.9	102.0	14.5	24.4	116.0
76	12.2	20.1	79.0	13.1	21.7	92.0	14.1	23.3	106.0	15.0	24.8	120.0
78	12.6	20.5	82.0	13.6	22.0	95.0	14.6	23.6	109.5	15.5	25.2	124.0
80	13.0	20.8	84.5	14.0	22.4	98.0	15.0	24.0	112.5	16.0	25.7	128.0
82	13.4	21.1	87.0	14.5	22.8	101.0	15.5	24.4	116.5	16.5	26.0	132.0
84	13.8	21.5	89.5	14.9	23.1	104.0	16.0	24.8	120.0	17.0	26.5	136.0
86	14.2	21.8	92.5	15.3	23.5	107.0	16.5	25.2	124.0	17.5	26.9	140.0
88	14.7	22.2	95.5	15.8	23.9	110.5	17.0	25.6	127.5	18.1	27.3	145.0
90	15.1	22.6	98.0	16.3	24.3	114.0	17.4	26.1	130.5	18.6	27.8	149.0
92	15.5	23.0	101.0	16.8	24.7	117.5	18.0	26.5	135.0	19.1	28.2	153.0
94	16.0	23.3	104.0	17.2	25.1	120.5	18.4	26.9	138.0	19.7	28.7	157.5
96	16.4	23.6	106.5	17.7	25.5	124.0	18.9	27.3	142.0	20.2	29.1	161.5
98	16.9	24.1	110.0	18.2	25.9	127.5	19.5	27.8	146.0	20.8	29.6	166.0
100	17.3	24.5	112.5	18.7	26.4	131.0	20.0	28.3	150.0	21.4	30.3	171.0



B=distance, in feet, cut into hillside from grade stake to toe of cut slope.
C=vertical cut, in feet, to be marked on cut stake.
S=distance along slope, to be measured from grade stake to cut stake.
A=area, in square feet, of cut section.
W=width of finished road.

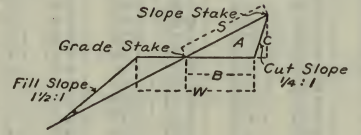
NOTE.—To obtain cubic yardage per 100 feet, multiply average end areas by 3.7.

Table XVI.—SLOPE STAKES AND AREAS—Continued

[For use on Forest Service minor roads] CUT SLOPE ¼:1

Slope, percent	Width of finished road															
	17				18				19				20			
	B	C	S	A	B	C	S	A	B	C	S	A	B	C	S	A
10	9.0	0.8	9.3	3.6	9.6	1.0	10.0	4.8	10.1	0.9	10.4	4.5	10.6	1.0	11.0	5.3
12	9.0	1.2	9.4	5.0	9.6	1.2	10.0	5.8	10.1	1.3	10.4	6.6	10.6	1.4	11.0	7.4
14	9.2	1.4	9.5	6.4	9.8	1.4	10.2	6.9	10.2	1.5	10.7	7.6	10.8	1.6	11.2	8.6
16	9.2	1.5	9.7	6.9	9.8	1.6	10.4	7.8	10.2	1.7	10.8	8.7	10.8	1.8	11.4	9.7
18	9.4	1.7	9.9	8.0	10.0	2.0	10.6	10.0	10.4	1.9	11.0	9.9	11.0	2.0	11.6	11.0
20	9.4	2.0	10.0	9.4	10.0	2.2	10.8	11.0	10.4	2.3	11.2	12.0	11.0	2.4	11.8	13.2
22	9.4	2.2	10.2	10.3	10.0	2.4	11.0	12.0	10.4	2.5	11.4	13.0	11.0	2.6	12.0	14.3
24	9.5	2.4	10.4	11.4	10.2	2.6	11.2	13.3	10.6	2.7	11.6	14.1	11.2	2.8	12.2	15.7
26	9.5	2.7	10.7	12.8	10.2	2.8	11.4	14.3	10.6	3.0	12.0	15.6	11.2	3.2	12.6	17.9
28	9.7	2.9	10.9	14.1	10.4	3.2	11.6	16.4	10.8	3.2	12.2	17.3	11.4	3.4	12.8	19.4
30	9.9	3.2	11.0	15.8	10.6	3.4	12.0	18.0	11.0	3.6	12.4	19.8	11.6	3.8	13.0	22.0
32	9.9	3.4	11.4	16.8	10.8	3.8	12.2	20.5	11.0	3.8	12.7	20.9	11.6	4.0	13.4	23.2
34	10.0	3.7	11.6	18.5	10.8	4.0	12.4	21.6	11.2	4.2	12.9	23.5	11.8	4.4	13.6	26.0
36	10.0	4.1	11.9	20.5	11.0	4.4	12.8	24.2	11.2	4.6	13.3	25.8	11.8	4.8	14.0	28.3
38	10.2	4.2	12.1	21.4	11.0	4.6	13.0	25.3	11.4	4.8	13.5	27.4	12.0	5.0	14.2	30.0
40	10.4	4.6	12.4	23.9	11.2	5.0	13.4	28.0	11.6	5.1	13.8	29.6	12.2	5.4	14.6	32.9
42	10.6	4.9	12.8	26.0	11.4	5.4	13.6	30.8	11.8	5.5	14.2	32.4	12.4	5.8	15.0	36.0
44	10.7	5.3	13.1	28.4	11.4	5.6	14.0	31.9	12.0	5.9	14.6	35.4	12.6	6.2	15.4	39.1
46	10.9	5.6	13.4	30.5	11.6	6.0	14.4	34.8	12.2	6.3	15.0	38.4	12.8	6.6	15.8	42.2
48	11.0	5.9	13.9	32.4	11.8	6.4	14.8	37.8	12.4	6.6	15.6	40.9	13.0	7.0	16.4	45.5
50	11.2	6.5	14.4	36.4	12.0	6.8	15.4	40.8	12.6	7.2	16.2	45.4	13.2	7.6	17.0	50.2
52	11.4	6.8	14.8	38.8	12.2	7.2	15.8	43.9	12.7	7.6	16.6	48.3	13.4	8.0	17.4	53.6
54	11.7	7.3	15.4	42.7	12.6	7.8	16.4	49.1	13.1	8.2	17.3	53.7	13.8	8.6	18.2	59.3
56	12.1	7.9	16.0	47.8	12.8	8.4	17.0	53.8	13.5	8.7	17.9	58.7	14.2	9.2	18.8	65.3
58	12.4	8.3	16.6	51.5	13.2	9.0	17.8	59.4	13.9	9.3	18.6	64.6	14.6	9.8	19.6	71.5
60	12.8	9.0	17.5	57.6	13.6	9.6	18.6	65.3	14.3	10.1	19.6	72.2	15.0	10.6	20.6	79.5
62	13.4	9.8	18.5	65.7	14.4	10.4	19.8	74.9	15.0	11.0	20.8	82.5	15.8	11.6	21.8	91.6
64	14.3	10.2	19.7	72.9	15.2	11.4	21.0	86.6	16.0	11.5	22.0	92.0	16.8	12.6	23.2	105.8
66	15.2	12.0	21.8	91.2	16.0	12.6	23.0	100.8	16.9	13.4	24.3	113.2	17.8	14.0	25.6	124.6
68	17.0	13.9	24.8	118.1	18.0	14.8	26.2	133.2	19.0	15.6	27.8	148.2	20.0	16.4	29.2	164.0

70	------	14.5	25.2	123.2	------	15.2	26.6	136.8	------	16.2	28.1	153.9	------	17.0	29.6	170.0
72	------	14.9	25.5	126.6	------	15.8	27.0	142.2	------	16.8	28.5	159.6	------	17.6	30.0	176.0
74	------	15.4	25.8	130.9	------	16.4	27.4	147.6	------	17.3	28.9	164.3	------	18.2	30.4	182.0
76	------	16.0	26.4	136.0	------	16.8	28.0	151.2	------	17.8	29.5	169.1	------	18.8	31.0	188.0
78	------	16.5	26.9	140.2	------	17.4	28.4	156.6	------	18.4	30.0	174.8	------	19.4	31.6	194.0
80	------	17.0	27.2	144.5	------	18.0	28.8	162.0	------	19.0	30.5	180.5	------	20.0	32.0	200.0
82	------	17.5	27.7	148.7	------	18.6	29.4	167.4	------	19.6	31.0	186.2	------	20.6	32.6	206.0
84	------	18.0	28.0	153.0	------	19.2	29.8	172.8	------	20.1	31.4	190.9	------	21.2	33.0	212.0
86	------	18.7	28.5	158.9	------	19.8	30.2	178.2	------	20.9	32.0	198.5	------	22.0	33.6	220.0
88	------	19.2	29.1	163.2	------	20.4	30.8	183.6	------	21.6	32.5	205.2	------	22.6	34.2	226.0
90	------	19.7	29.6	167.4	------	21.0	31.2	189.0	------	22.0	33.0	209.0	------	23.2	34.8	232.0
92	------	20.4	30.0	173.4	------	21.6	31.8	194.4	------	22.8	33.5	216.6	------	24.0	35.2	240.0
94	------	20.9	30.5	177.6	------	22.2	32.2	199.8	------	23.4	34.0	222.3	------	24.6	35.8	246.0
96	------	21.4	31.0	181.9	------	22.8	32.8	205.2	------	23.9	34.6	227.0	------	25.2	36.4	252.0
98	------	22.1	31.3	187.8	------	23.4	33.6	210.6	------	24.7	35.2	234.6	------	26.0	37.0	260.0
100	------	22.8	32.2	193.8	------	24.0	34.0	216.0	------	25.5	36.0	242.2	------	26.8	37.8	268.0



B = distance, in feet, cut into hillside from grade stake to toe of cut slope.
C = vertical cut, in feet, to be marked on cut stake.
S = distance along slope, to be measured from grade stake to cut stake.
A = area, in square feet, of cut section.
W = width of finished road.

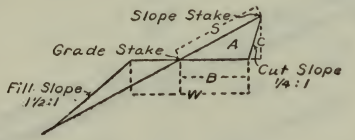
NOTE.—To obtain cubic yardage per 100 feet, multiply average end areas by 3.7.

Table XVI.—SLOPE STAKES AND AREAS—Continued

[For use on Forest Service minor roads] CUT SLOPE ¼:1

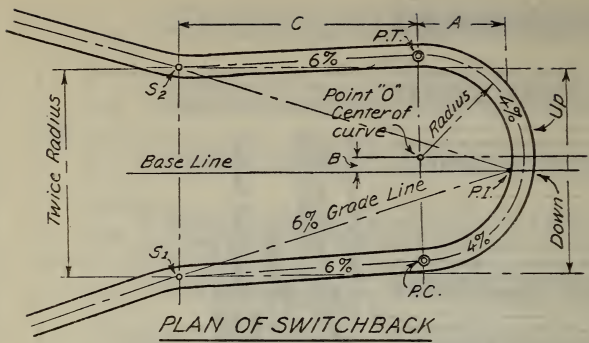
Slope, percent	Width of finished road															
	21				22				23				24			
	B	C	S	A	B	C	S	A	B	C	S	A	B	C	S	A
10	11.2	1.1	11.6	6.2	11.8	1.2	12.2	7.1	12.2	1.2	12.7	7.6	12.8	1.4	13.4	9.0
12	11.2	1.5	11.6	8.4	11.8	1.4	12.4	8.3	12.2	1.6	12.7	10.2	12.8	1.6	13.4	10.2
14	11.4	1.7	11.8	9.7	12.0	1.8	12.4	10.8	12.4	1.8	12.9	11.6	13.0	2.0	13.6	13.0
16	11.4	1.9	12.0	10.8	12.0	2.0	12.6	12.0	12.4	2.1	13.1	13.8	13.0	2.2	14.0	14.3
18	11.6	2.1	12.2	12.2	12.2	2.4	12.8	14.6	12.7	2.3	13.3	15.3	13.2	2.6	14.2	17.2
20	11.6	2.5	12.4	14.5	12.2	2.6	13.2	15.9	12.7	2.8	13.6	19.0	13.4	2.8	14.4	18.8
22	11.6	2.7	12.6	15.7	12.2	2.8	13.4	17.1	12.7	3.0	13.8	20.7	13.4	3.2	14.6	21.4
24	11.8	2.9	12.8	17.1	12.4	3.2	13.6	19.8	12.9	3.2	14.0	22.4	13.6	3.6	15.0	24.5
26	11.8	3.4	13.2	20.1	12.4	3.6	13.8	22.3	12.9	3.7	14.5	26.8	13.6	3.8	15.2	25.8
28	12.0	3.6	13.4	21.6	12.6	3.8	14.2	23.9	13.1	3.9	14.7	28.7	13.8	4.2	15.4	28.6
30	12.2	4.0	13.6	24.4	12.8	4.2	14.4	26.9	13.3	4.4	15.0	33.0	14.0	4.6	15.8	32.2
32	12.2	4.2	14.1	25.6	12.8	4.6	14.8	29.4	13.3	4.6	15.4	35.4	14.2	5.0	16.2	35.5
34	12.4	4.6	14.3	28.5	13.0	4.8	15.2	31.2	13.6	5.1	15.6	39.8	14.4	5.4	16.4	38.9
36	12.4	5.0	14.6	31.0	13.2	5.2	15.4	34.3	13.6	5.5	16.1	44.3	14.4	5.8	16.8	41.8
38	12.6	5.2	14.9	32.8	13.4	5.6	15.8	37.5	13.8	5.8	16.3	47.3	14.6	6.2	17.2	45.3
40	12.8	5.7	15.4	36.5	13.6	6.0	16.2	40.8	14.0	6.2	16.8	52.1	14.8	6.6	17.8	48.8
42	13.0	6.1	15.8	39.6	13.8	6.4	16.6	44.2	14.3	6.7	17.3	58.0	15.0	7.0	18.2	52.5
44	13.2	6.5	16.2	42.9	14.0	6.8	17.0	47.6	14.5	7.1	17.7	62.8	15.2	7.6	18.8	57.8
46	13.4	6.9	16.6	46.2	14.2	7.4	17.6	52.5	14.7	7.6	18.2	69.2	15.4	8.0	19.2	61.6
48	13.6	7.3	17.2	49.6	14.4	7.8	18.0	56.2	15.0	8.1	18.9	76.5	15.6	8.6	19.8	67.1
50	13.8	8.0	17.8	55.2	14.6	8.4	18.6	61.3	15.2	8.7	19.6	85.3	16.0	9.2	20.4	73.6
52	14.0	8.4	18.3	58.8	15.0	9.0	19.4	63.0	15.4	9.2	20.0	92.0	16.4	9.8	21.0	80.4
54	14.5	9.0	19.1	65.2	15.4	9.6	20.0	73.9	15.9	9.9	20.9	103.5	16.8	10.4	21.8	87.4
56	15.0	9.7	19.7	72.7	15.8	10.2	20.8	80.6	16.3	10.6	21.6	114.5	17.2	11.2	22.6	96.3
58	15.3	10.3	20.6	78.8	16.2	10.8	21.6	87.5	16.8	11.3	22.5	127.1	17.6	11.8	23.6	103.8
60	15.8	11.2	21.6	88.5	16.6	11.8	22.6	97.9	17.3	12.2	23.7	144.6	18.0	12.8	24.8	115.2
62	16.6	12.2	23.0	101.3	17.6	12.6	24.0	110.9	18.2	13.3	25.1	166.9	19.0	13.8	26.2	131.1
64	17.7	12.7	24.4	112.4	18.6	13.8	25.6	128.3	19.3	14.5	26.7	193.6	20.2	15.0	28.0	151.5
66	18.7	14.8	27.0	138.4	19.6	15.6	28.0	152.9	20.5	16.1	29.4	236.7	21.4	17.0	30.8	181.9
68	21.0	17.2	30.6	180.6	22.0	18.0	32.0	198.0	23.0	18.9	33.6	317.5	24.0	19.6	35.0	235.2

70	17.8	31.0	186.9		18.6	32.6	204.6		19.6	34.0	333.2		20.4	35.4	244.8
72	18.5	31.4	194.2		19.6	33.0	215.6		20.2	34.5	348.5		21.0	36.0	252.0
74	19.1	31.9	200.5		20.0	33.6	220.0		20.9	35.0	365.8		21.8	36.6	261.6
76	19.7	32.5	206.8		20.6	34.0	226.6		21.6	35.7	385.6		22.4	37.2	268.8
78	20.4	33.2	214.2		21.4	34.6	235.4		22.3	36.3	404.7		23.2	37.8	278.4
80	21.0	33.5	220.5		22.0	35.2	242.0		23.0	36.8	423.2		24.0	38.4	288.0
82	21.6	34.2	226.8		22.6	35.8	248.6		23.7	37.5	444.4		24.8	39.0	297.6
84	22.2	34.6	233.1		23.4	36.4	257.4		24.4	38.0	463.6		25.4	39.6	304.8
86	23.1	35.3	242.5		24.2	37.0	266.2		25.3	38.6	488.3		26.2	40.2	314.4
88	23.8	35.9	249.9		24.8	37.6	272.8		26.0	39.3	510.9		27.0	41.0	324.0
90	24.4	36.5	256.2		25.6	38.2	281.6		26.7	40.0	534.0		27.8	41.6	333.6
92	25.2	37.0	264.6		26.2	38.8	288.2		27.6	40.5	558.9		28.6	42.2	343.2
94	25.8	37.5	270.9		27.0	39.4	297.0		28.3	41.2	583.0		29.4	43.0	352.8
96	26.5	38.2	278.2		27.8	40.0	305.8		29.0	41.9	607.6		30.2	43.6	362.4
98	27.3	38.8	286.6		28.6	40.8	314.6		29.9	42.6	636.9		31.2	44.4	374.4
100	28.1	39.6	295.1		29.6	41.6	325.6		30.8	43.5	669.9		32.0	45.4	384.0



B = distance, in feet, cut into hillside from grade stake to toe of cut slope.
C = vertical cut, in feet, to be marked on cut stake.
S = distance, along slope, to be measured from grade stake to cut stake.
A = area, in square feet, of cut section.
W = width of finished road.

NOTE.—To obtain cubic yardage per 100 feet, multiply average end areas by 3.7.



PLAN OF SWITCHBACK

Tangent 6% and Curve 4% Grades

40 FOOT RADIUS CURVE

Ground Slope	A	B	C
10%	28.4	2.0	25.0
15%	33.1	3.0	58.3
20%	35.4	4.3	91.6
25%	37.0	5.5	125.0
30%	37.7	6.7	158.3
35%	38.0	7.8	191.6
40%	38.4	8.8	225.0

50 FOOT RADIUS CURVE

Ground Slope	A	B	C
10%	35.5	2.7	31.3
15%	41.4	4.3	72.9
20%	44.3	5.7	114.5
25%	46.3	7.0	156.3
30%	47.1	8.2	197.9
35%	47.5	9.4	239.5
40%	48.0	10.4	281.3

60 FOOT RADIUS CURVE

Ground Slope	A	B	C
10%	42.6	3.5	37.5
15%	49.7	5.5	87.5
20%	53.1	7.1	137.4
25%	55.5	8.5	187.5
30%	56.5	9.8	237.5

80 FOOT RADIUS CURVE

Ground Slope	A	B	C
10%	56.8	5.0	50.0
15%	66.2	8.0	116.7
20%	70.8	10.0	183.3
25%	74.0	11.7	250.0
30%	75.4	13.0	316.7

METHOD AND TABLES FOR STAKING OUT SWITCHBACKS

WITH 10% MORE CUT THAN FILL

Cut Banks $\frac{3}{4}$:1 Fill Slope $1\frac{1}{2}$:1

FIGURE 14.

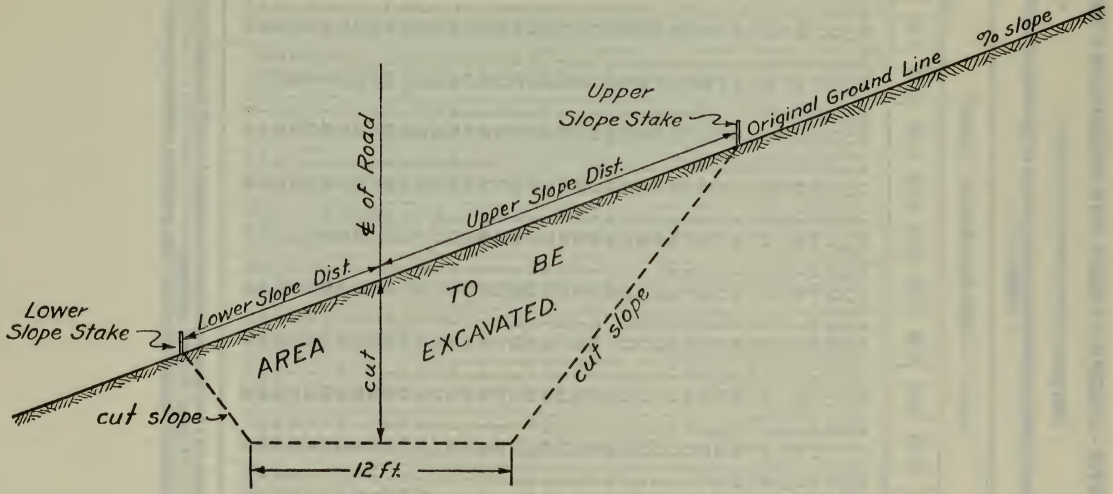


FIGURE 15.

For slope distances for various cuts at center line, see table XVII.

Table XVII.—SLOPE STAKES FOR THROUGH CUTS

[For use on Forest Service truck trails] **Cut slope 1:1**

[Distances to upper and lower slope stake from center line for 12-foot width of roadway without ditch [1]]

Cut at center line (feet)	Side slope of ground (percent)											
	5	10	15	20	25	30	35	40	45	50	55	60
1---Upper--	7.4	7.8	8.3	8.9	9.6	10.4	11.4	12.6	14.0	15.6	17.8	20.4
Lower--	6.7	6.4	6.1	[2] 5.9	[2] 5.8	[2] 5.7	[2] 5.5	[2] 5.4	[2] 5.3	[2] 5.2	[2] 5.1	[2] 5.1
2---Upper--	8.4	8.9	9.5	10.2	11.0	11.9	13.0	14.3	16.0	17.9	20.3	23.3
Lower--	7.6	7.3	7.0	6.8	6.6	6.4	6.2	6.2	6.1	6.0	[2] 5.9	5.8
3---Upper--	9.5	10.0	10.7	11.5	12.4	13.4	14.7	16.1	18.0	20.1	22.8	26.2
Lower--	8.6	8.2	7.9	7.6	7.4	7.2	7.1	6.9	6.8	6.7	6.7	6.7
4---Upper--	10.5	11.2	11.9	12.7	13.8	14.9	16.3	17.9	20.0	22.4	25.4	29.1
Lower--	9.5	9.1	8.8	8.5	8.2	8.0	7.8	7.7	7.6	7.4	7.4	7.3
5---Upper--	11.6	12.3	13.1	14.0	15.1	16.4	17.9	19.7	22.0	24.6	27.9	32.1
Lower--	10.5	10.0	9.7	9.3	9.1	8.8	8.6	8.5	8.3	8.2	8.1	8.0
6---Upper--	12.6	13.4	14.3	15.3	16.5	17.9	19.6	21.5	24.0	26.8	30.4	35.0
Lower--	11.4	11.0	10.5	10.2	9.9	9.6	9.4	9.2	9.1	8.9	8.8	8.7
7---Upper--	13.7	14.5	15.4	16.6	17.9	19.4	21.2	23.3	26.0	29.1	33.0	37.9
Lower--	12.4	11.9	11.4	11.0	10.7	10.4	10.1	10.0	9.8	9.7	9.6	9.5
8---Upper--	14.7	15.6	16.6	17.8	19.3	20.9	22.8	25.1	28.0	31.3	35.5	40.8
Lower--	13.3	12.8	12.3	11.9	11.5	11.2	11.0	10.7	10.6	10.4	10.3	10.2
9---Upper--	15.8	16.7	17.8	19.1	20.6	22.4	24.4	26.9	30.0	33.5	38.1	43.7
Lower--	14.3	13.7	13.2	12.7	12.4	12.0	11.8	11.5	11.4	11.2	11.0	10.9
10---Upper--	16.8	17.9	19.0	20.4	22.0	23.8	26.1	28.7	32.0	35.8	40.6	46.6
Lower--	15.2	14.6	14.1	13.6	13.2	12.8	12.6	12.3	12.1	11.9	11.8	11.6
11---Upper--	17.9	19.0	20.2	21.7	23.4	25.3	27.7	30.5	34.0	38.0	43.1	49.5
Lower--	16.2	15.5	14.9	14.4	14.0	13.6	13.3	13.1	12.9	12.7	12.5	12.4
12---Upper--	18.9	20.1	21.4	22.9	24.8	26.8	29.3	32.3	36.0	40.2	45.7	52.2
Lower--	17.1	16.4	15.8	15.3	14.9	14.4	14.1	13.8	13.6	13.4	13.3	13.1
13---Upper--	20.0	21.2	22.6	24.2	25.1	28.3	31.0	34.1	38.0	42.5	48.2	55.4
Lower--	18.1	17.3	16.7	16.1	15.7	15.2	14.9	14.6	14.4	14.2	14.0	13.8
14---Upper--	21.0	22.3	23.8	25.5	27.5	29.8	32.6	35.9	40.0	44.7	50.7	58.3
Lower--	19.0	18.3	17.6	17.0	16.5	16.0	15.7	15.4	15.1	14.9	14.7	14.6
15---Upper--	22.1	23.4	25.0	26.8	28.9	31.3	34.2	37.7	42.0	47.0	53.3	61.2
Lower--	20.0	19.2	18.5	17.8	17.3	16.8	16.5	16.1	15.9	15.6	15.5	15.3
16---Upper--	23.1	24.6	26.1	28.0	30.3	32.8	35.9	39.5	44.0	49.2	55.8	64.1
Lower--	21.0	20.1	19.3	18.7	18.2	17.6	17.3	17.0	16.7	16.4	16.2	16.0
17---Upper--	24.2	25.7	27.3	29.3	31.6	34.3	37.5	41.3	46.0	51.4	58.4	67.0
Lower--	21.9	21.0	20.2	19.5	19.0	18.5	18.1	17.7	17.4	17.1	16.9	16.8
18---Upper--	25.2	26.8	28.5	30.6	32.0	35.8	39.1	43.1	48.0	53.7	60.9	70.0
Lower--	22.9	21.9	21.1	20.4	19.8	19.3	18.8	18.5	18.2	17.9	17.7	17.5
19---Upper--	26.3	27.9	29.7	30.9	33.4	37.3	40.7	44.9	50.0	55.9	63.4	72.9
Lower--	23.8	22.8	22.0	21.2	20.6	20.1	19.6	19.2	18.9	18.6	18.4	18.2
20---Upper--	27.4	29.0	30.9	31.9	34.8	38.8	42.4	46.7	52.0	58.1	66.0	75.8
Lower--	24.8	23.7	22.8	22.1	21.5	20.9	20.4	20.0	19.7	19.4	19.1	18.9

[1] In case the width of 12 feet is increased, use the table as it is and increase horizontally from the slope stake the additional distance required.

[2] The slope distance out from center stake where grade line intersects ground line.

Table XVII.—SLOPE STAKES FOR THROUGH CUTS—Continued

[For use on Forest Service truck trails] **Cut slope 3/4:1**

[Distances to upper and lower slope stake from center line for 12-foot width of roadway without ditch [1]]

Cut at center line (feet)	Side slope of ground (percent)											
	5	10	15	20	25	30	35	40	45	50	55	60
1 Upper	7.0	7.3	7.7	8.1	8.6	9.1	9.5	10.4	11.2	12.1	13.1	14.3
Lower	6.5	6.3	6.1	[2] 5.1	[2] 4.1	[2] 3.3	[2] 3.0	[2] 2.7	[2] 2.4	[2] 2.2	[2] 2.0	[2] 1.9
2 Upper	7.8	8.2	8.6	9.0	9.5	10.1	10.6	11.5	12.5	13.4	14.6	15.9
Lower	7.2	7.0	6.8	6.6	6.5	6.4	6.1	[2] 5.4	[2] 4.9	[2] 4.5	[2] 4.1	[2] 3.9
3 Upper	8.6	9.0	9.4	9.9	10.5	11.1	11.7	12.7	13.7	14.8	16.1	17.5
Lower	7.9	7.7	7.5	7.3	7.2	7.0	6.9	6.8	6.7	6.7	6.2	6.0
4 Upper	9.4	9.9	10.3	10.8	11.4	12.1	12.8	13.9	15.0	16.1	17.5	19.1
Lower	8.7	8.4	8.2	8.0	7.8	7.7	7.6	7.4	7.4	7.3	7.3	7.2
5 Upper	10.1	10.6	11.1	11.7	12.4	13.1	13.8	15.0	16.2	17.5	19.0	20.7
Lower	9.4	9.1	8.9	8.6	8.5	8.3	8.2	8.1	8.0	7.9	7.9	7.8
6 Upper	10.9	11.4	12.0	12.6	13.3	14.2	14.9	16.2	17.4	18.8	20.5	22.3
Lower	10.1	9.8	9.5	9.3	9.1	8.9	8.8	8.7	8.6	8.5	8.5	8.4
7 Upper	11.7	12.2	12.8	13.5	14.3	15.2	16.0	17.3	18.7	20.2	21.9	23.9
Lower	10.8	10.5	10.2	10.0	9.8	9.6	9.5	9.3	9.2	9.1	9.1	9.0
8 Upper	12.5	13.1	13.7	14.4	15.3	16.2	17.1	18.5	19.9	21.5	23.4	25.5
Lower	11.6	11.2	10.9	10.6	10.4	10.2	10.1	9.9	9.8	9.7	9.7	9.6
9 Upper	13.3	13.9	14.5	15.3	16.2	17.2	18.2	19.7	21.2	22.9	24.9	27.1
Lower	12.3	11.9	11.6	11.3	11.1	10.9	10.7	10.6	10.5	10.4	10.3	10.2
10 Upper	14.1	14.7	15.4	16.2	17.2	18.2	19.3	20.8	22.4	24.2	26.3	28.7
Lower	13.0	12.6	12.3	12.0	11.7	11.5	11.3	11.2	11.1	11.0	10.9	10.8
11 Upper	14.8	15.5	16.3	17.1	18.1	19.2	20.3	22.0	23.7	25.6	27.8	30.3
Lower	13.7	13.3	13.0	12.6	12.4	12.1	12.0	11.8	11.7	11.6	11.5	11.5
12 Upper	15.6	16.3	17.1	18.3	19.1	20.2	21.4	23.1	24.9	26.9	29.2	31.9
Lower	14.5	14.0	13.6	13.3	13.0	12.8	12.6	12.4	12.3	12.2	12.1	12.1
13 Upper	16.4	17.1	18.0	18.9	20.0	21.3	22.5	24.3	26.2	28.2	30.7	33.5
Lower	15.2	14.7	14.3	14.0	13.7	13.4	13.2	13.1	12.9	12.8	12.7	12.7
14 Upper	17.2	18.0	18.8	19.8	21.0	22.3	23.6	25.4	27.4	29.6	32.2	35.1
Lower	15.9	15.4	15.0	14.6	14.3	14.1	13.9	13.7	13.6	13.4	13.3	13.3
15 Upper	17.9	18.8	19.7	20.7	21.9	23.3	24.7	26.6	28.7	30.9	33.6	36.7
Lower	16.6	16.1	15.7	15.3	15.0	14.7	14.5	14.3	14.2	14.0	13.9	13.9
16 Upper	18.7	19.6	20.5	21.6	22.9	24.3	25.7	27.8	29.9	32.3	35.1	38.3
Lower	17.4	16.8	16.4	16.0	15.7	15.3	15.1	14.9	14.8	14.6	14.5	14.5
17 Upper	19.5	20.4	21.4	22.5	23.9	25.3	26.8	28.9	31.2	33.6	36.6	39.9
Lower	18.1	17.5	17.1	16.6	16.3	16.0	15.8	15.5	15.4	15.3	15.2	15.1
18 Upper	20.3	21.2	22.3	23.4	24.8	26.3	27.9	30.1	32.4	35.0	38.0	41.5
Lower	18.8	18.2	17.7	17.3	17.0	16.6	16.4	16.2	16.0	15.9	15.8	15.7
19 Upper	21.1	22.0	23.1	25.3	25.8	27.3	29.0	31.2	33.7	36.3	39.5	43.1
Lower	19.5	18.9	18.4	18.0	17.6	17.3	17.0	16.8	16.6	16.5	16.4	16.3
20 Upper	21.9	22.9	24.0	26.2	26.7	28.4	30.1	32.4	34.9	37.7	41.0	44.7
Lower	20.3	19.7	19.1	18.6	18.3	17.9	17.7	17.4	17.3	17.1	17.0	16.9

[1] In case the width of 12 feet is increased, used the table as it is and increase horizontally from the slope stake the additional distance required.

[2] The slope distance out from center stake where grade line intersects ground line.

Table XVII.—SLOPE STAKES FOR THROUGH CUTS—Continued

[For use on Forest Service truck trails] **CUT SLOPE 1/2:1**

[Distances to upper and lower slope stake from center line for 12-foot width of roadway without ditch [1]]

Cut at center line (feet)	Side slope of ground (percent)											
	5	10	15	20	25	30	35	40	45	50	55	60
1---Upper--	6.6	6.8	7.0	7.2	7.5	7.7	8.0	8.3	8.6	9.0	9.5	9.8
Lower--	6.3	6.2	6.0	[2] 5.9	[2] 5.7	[2] 5.6	[2] 5.5	[2] 5.4	[2] 5.2	[2] 5.1	[2] 5.0	[2] 4.8
2---Upper--	7.2	7.4	7.6	7.8	8.1	8.3	8.6	9.0	9.4	9.7	10.2	10.7
Lower--	6.8	6.7	6.5	6.3	6.1	[2] 5.9	[2] 5.9	[2] 5.8	[2] 5.7	[2] 5.6	[2] 5.4	[2] 5.3
3---Upper--	7.7	7.9	8.1	8.4	8.7	8.9	9.2	9.7	10.1	10.5	11.0	11.5
Lower--	7.3	7.1	7.0	6.8	6.7	6.5	6.4	6.3	6.1	6.0	[2] 5.9	[2] 5.7
4---Upper--	8.2	8.4	8.7	8.9	9.2	9.5	9.9	10.3	10.8	11.2	11.8	12.4
Lower--	7.8	7.6	7.5	7.3	7.1	7.0	6.9	6.7	6.6	6.4	6.3	6.2
5---Upper--	8.7	8.9	9.2	9.5	9.7	10.2	10.6	11.0	11.5	12.0	12.5	13.2
Lower--	8.3	8.1	7.9	7.8	7.6	7.4	7.3	7.2	7.0	6.9	6.8	6.6
6---Upper--	9.2	9.5	9.8	10.1	10.4	10.8	11.2	11.7	12.2	12.7	13.4	14.0
Lower--	8.8	8.6	8.4	8.2	8.1	7.9	7.8	7.6	7.5	7.3	7.2	7.1
7---Upper--	9.7	10.0	10.3	10.6	11.0	11.4	11.8	12.4	13.0	13.5	14.1	14.9
Lower--	9.3	9.0	8.9	8.7	8.5	8.4	8.3	8.3	7.9	7.8	7.7	7.5
8---Upper--	10.3	10.5	10.9	11.2	11.6	12.0	12.6	13.0	13.7	14.2	14.9	15.7
Lower--	9.8	9.5	9.3	9.1	9.0	8.8	8.7	8.5	8.4	8.2	8.1	8.0
9---Upper--	10.8	11.1	11.4	11.8	12.2	12.6	13.1	13.7	14.4	15.0	15.7	16.5
Lower--	10.2	10.0	9.8	9.6	9.4	9.3	9.1	9.0	8.8	8.7	8.5	8.4
10---Upper--	11.3	11.6	11.9	12.3	12.8	13.2	13.8	14.4	15.1	15.7	16.4	17.4
Lower--	10.7	10.5	10.3	10.0	9.9	9.7	9.6	9.4	9.3	9.1	9.0	8.9
11---Upper--	11.8	12.1	12.5	12.9	13.3	13.8	14.4	15.0	15.8	16.5	17.2	18.2
Lower--	11.2	11.0	10.7	10.5	10.3	10.2	10.0	9.9	9.7	9.6	9.4	9.3
12---Upper--	12.3	12.6	13.0	13.5	13.9	14.4	15.1	15.7	16.5	17.2	18.0	19.0
Lower--	11.7	11.4	11.2	11.0	10.8	10.6	10.5	10.3	10.2	10.0	9.9	9.8
13---Upper--	12.8	13.2	13.6	14.0	14.5	15.0	15.7	16.4	17.1	17.9	18.8	19.9
Lower--	12.2	11.9	11.7	11.4	11.3	11.1	10.9	10.8	10.6	10.5	10.3	10.2
14---Upper--	13.3	13.7	14.1	14.6	15.1	15.7	16.3	17.0	17.9	18.7	19.6	20.7
Lower--	12.7	12.4	12.1	11.9	11.7	11.5	11.4	11.2	11.1	10.9	10.8	10.7
15---Upper--	13.9	14.2	14.7	15.2	15.7	16.3	17.0	17.7	18.6	19.4	20.4	21.5
Lower--	13.2	12.9	12.6	12.3	12.2	12.0	11.8	11.7	11.5	11.4	11.2	11.1
16---Upper--	14.4	14.7	15.2	15.7	16.3	16.9	17.6	18.4	19.3	20.2	21.2	22.4
Lower--	13.7	13.3	13.1	12.8	12.6	12.4	12.3	12.1	12.0	11.8	11.7	11.6
17---Upper--	14.9	15.3	15.8	16.3	16.9	17.5	18.3	19.1	20.0	20.9	22.0	23.2
Lower--	14.1	13.8	13.6	13.3	13.1	12.9	12.7	12.6	12.4	12.3	12.1	12.0
18---Upper--	15.4	15.8	16.3	16.9	17.5	18.1	18.9	19.8	20.6	21.7	22.8	24.0
Lower--	14.6	14.3	14.0	13.7	13.5	13.3	13.2	13.0	12.9	12.7	12.6	12.5
19---Upper--	15.9	16.3	16.9	17.4	18.1	18.7	19.5	20.5	21.3	22.4	23.5	24.9
Lower--	15.1	14.8	14.5	14.2	14.0	13.8	13.6	13.5	13.3	13.2	13.0	12.9
20---Upper--	16.4	16.8	17.4	18.0	18.7	19.3	20.2	21.1	22.0	23.2	24.3	24.8
Lower--	15.6	15.2	15.0	14.7	14.4	14.3	14.1	13.9	13.8	13.6	13.5	13.4

[1] In case the width of 12 feet is increased, use the table as it is and inc ease horizontally from the slope stake the additional distance required.

[2] The slope distance out from center stake where grade line intersects ground line.

Table XVII.—SLOPE STAKES FOR THROUGH CUTS—Continued

[For use on Forest Service truck trails] **CUT SLOPE 1/4 : 1**

[Distances to upper and lower slope stake from center line for 12-foot width of roadway without ditch [1]]

Cut at center line (feet)	Side slope of ground (percent)											
	5	10	15	20	25	30	35	40	45	50	55	60
1---Upper--	6.3	6.4	6.5	6.8	6.9	7.1	7.2	7.5	7.7	7.8	8.2	8.6
Lower--	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.2	6.2
2---Upper--	6.6	6.7	6.7	7.0	7.2	7.3	7.5	7.8	8.0	8.2	8.5	8.9
Lower--	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.4	6.4	6.4	6.5	6.6
3---Upper--	6.8	6.9	7.0	7.2	7.4	7.6	7.7	8.2	8.3	8.6	8.9	9.3
Lower--	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.7	6.8
4---Upper--	7.1	7.2	7.3	7.5	7.7	7.8	8.0	8.5	8.7	8.9	9.3	9.6
Lower--	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.9	6.9	6.9	7.0	7.0
5---Upper--	7.3	7.4	7.5	7.7	8.0	8.2	8.4	8.8	9.0	9.2	9.5	10.0
Lower--	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.2	7.2	7.3	7.4
6---Upper--	7.6	7.7	7.8	8.0	8.3	8.4	8.7	9.1	9.3	9.6	9.9	10.3
Lower--	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.4	7.4	7.5	7.6
7---Upper--	7.9	8.0	8.0	8.3	8.5	8.7	9.0	9.4	9.6	9.9	10.2	10.6
Lower--	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.6	7.7	7.8	7.9
8---Upper--	8.1	8.2	8.3	8.5	8.8	9.0	9.3	9.7	9.9	10.2	10.6	11.0
Lower--	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.9	7.9	8.0	8.1
9---Upper--	8.4	8.5	8.6	8.8	9.1	9.3	9.6	10.0	10.2	10.5	10.9	11.3
Lower--	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.2	8.2	8.3	8.4
10---Upper--	8.6	8.7	8.8	9.1	9.3	9.6	9.9	10.3	10.5	10.8	11.4	11.7
Lower--	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.4	8.4	8.5	8.6
11---Upper--	8.9	9.0	9.1	9.3	9.6	9.8	10.2	10.6	10.8	11.2	11.5	12.0
Lower--	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.6	8.7	8.7	8.8	8.9
12---Upper--	9.1	9.2	9.4	9.6	9.9	10.1	10.4	10.9	11.1	11.5	11.9	12.4
Lower--	8.8	8.8	8.8	8.8	8.8	8.7	8.8	8.8	8.9	8.9	9.0	9.1
13---Upper--	9.4	9.5	9.6	9.8	10.1	10.4	10.7	11.2	11.4	11.8	12.2	12.7
Lower--	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.1	9.2	9.2	9.3	9.4
14---Upper--	9.6	9.8	9.9	10.1	10.4	10.7	11.0	11.5	11.8	12.1	12.5	13.0
Lower--	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.4	9.4	9.5	9.6
15---Upper--	9.9	10.0	10.1	10.4	10.7	11.0	11.3	11.8	12.1	12.5	12.9	13.4
Lower--	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.6	9.6	9.7	9.8	9.9
16---Upper--	10.1	10.3	10.4	10.6	11.0	11.3	11.6	12.1	12.4	12.8	13.3	13.8
Lower--	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.9	9.9	10.0	10.1
17---Upper--	10.4	10.5	10.7	10.9	11.2	11.5	11.9	12.4	12.7	13.1	13.6	14.1
Lower--	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.1	10.2	10.2	10.3	10.4
18---Upper--	10.5	10.8	10.9	11.1	11.5	11.8	12.2	12.7	13.0	13.4	14.0	14.4
Lower--	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.4	10.4	10.6	10.7
19---Upper--	10.9	11.0	11.2	11.4	11.8	12.1	12.5	13.0	13.3	13.7	14.3	14.8
Lower--	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.6	10.6	10.7	10.8	10.9
20---Upper--	11.1	11.3	11.5	11.7	12.1	12.4	12.8	13.3	13.7	14.1	14.5	15.1
Lower--	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.8	10.8	10.9	11.0	11.2

[1] In case the width of 12 feet is increased, use the table as it is and increase horizontally from the slope stake the additional distance required.

Table XVIII.—VOLUMES

[Cubic yards for sum of end areas 100 feet apart]

1,200	1,100	1,000	900	800	700	600	500	400	300	200	100	00	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
648	594	540	486	432	378	324	270	216	162	108	54	0	0.00	0.19	0.37	0.56	0.74	0.93	1.11	1.30	1.48	1.67
649	595	541	487	433	379	325	271	217	163	109	55	1	1.85	2.04	2.22	2.41	2.59	2.78	2.96	3.15	3.33	3.52
650	596	542	488	434	380	326	272	218	164	110	56	2	3.70	3.89	4.07	4.26	4.44	4.63	4.81	5.00	5.19	5.37
651	597	543	489	435	381	327	273	219	165	111	57	3	5.56	5.74	5.93	6.11	6.30	6.48	6.67	6.85	7.04	7.22
652	598	544	490	436	382	328	274	220	166	112	58	4	7.41	7.59	7.78	7.96	8.15	8.33	8.52	8.70	8.89	9.07
653	599	545	491	437	383	329	275	221	167	113	59	5	9.26	9.44	9.63	9.81	10.00	10.19	10.37	10.56	10.74	10.93
654	600	546	492	438	384	330	276	222	168	114	60	6	11.11	11.30	11.48	11.67	11.85	12.04	12.22	12.41	12.59	12.78
655	601	547	493	439	385	331	277	223	169	115	61	7	12.96	13.15	13.33	13.52	13.70	13.89	14.07	14.26	14.44	14.63
656	602	548	494	440	386	332	278	224	170	116	62	8	14.81	15.00	15.19	15.37	15.56	15.74	15.93	16.11	16.30	16.48
657	603	549	495	441	387	333	279	225	171	117	63	9	16.67	16.85	17.04	17.22	17.41	17.59	17.78	17.96	18.15	18.33
658	604	550	496	442	388	334	280	226	172	118	64	10	18.52	18.70	18.89	19.07	19.26	19.44	19.63	19.81	20.00	20.19
659	605	551	497	443	389	335	281	227	173	119	65	11	20.37	20.56	20.74	20.93	21.11	21.30	21.48	21.67	21.85	22.04
660	606	552	498	444	390	336	282	228	174	120	66	12	22.22	22.41	22.59	22.78	22.96	23.15	23.33	23.52	23.70	23.89
661	607	553	499	445	391	337	283	229	175	121	67	13	24.07	24.26	24.44	24.63	24.81	25.00	25.19	25.37	25.56	25.74
662	608	554	500	446	392	338	284	230	176	122	68	14	25.93	26.11	26.30	26.48	26.67	26.85	27.04	27.22	27.41	27.59
663	609	555	501	447	393	339	285	231	177	123	69	15	27.78	27.96	28.15	28.33	28.52	28.70	28.89	29.07	29.26	29.44
664	610	556	502	448	394	340	286	232	178	124	70	16	29.63	29.81	30.00	30.19	30.37	30.56	30.74	30.93	31.11	31.30
665	611	557	503	449	395	341	287	233	179	125	71	17	31.48	31.67	31.85	32.04	32.22	32.41	32.59	32.78	32.96	33.15
666	612	558	504	450	396	342	288	234	180	126	72	18	33.33	33.52	33.70	33.89	34.07	34.26	34.44	34.63	34.81	35.00
667	613	559	505	451	397	343	289	235	181	127	73	19	35.19	35.37	35.56	35.74	35.93	36.11	36.30	36.48	36.67	36.85
668	614	560	506	452	398	344	290	236	182	128	74	20	37.04	37.22	37.41	37.59	37.78	37.96	38.15	38.33	38.52	38.70
669	615	561	507	453	399	345	291	237	183	129	75	21	38.89	39.07	39.26	39.44	39.63	39.81	40.00	40.19	40.37	40.56
670	616	562	508	454	400	346	292	238	184	130	76	22	40.74	40.93	41.11	41.30	41.48	41.67	41.85	42.04	42.22	42.41
671	617	563	509	455	401	347	293	239	185	131	77	23	42.59	42.78	42.96	43.15	43.33	43.52	43.70	43.89	44.07	44.26
672	618	564	510	456	402	348	294	240	186	132	78	24	44.44	44.63	44.81	45.00	45.19	45.37	45.56	45.74	45.93	46.11
673	619	565	511	457	403	349	295	241	187	133	79	25	46.30	46.48	46.67	46.85	47.04	47.22	47.41	47.59	47.78	47.96
674	620	566	512	458	404	350	296	242	188	134	80	26	48.15	48.33	48.52	48.70	48.89	49.07	49.26	49.44	49.63	49.81
675	621	567	513	459	405	351	297	243	189	135	81	27	50.00	50.19	50.37	50.56	50.74	50.93	51.11	51.30	51.48	51.67
676	622	568	514	460	406	352	298	244	190	136	82	28	51.85	52.04	52.22	52.41	52.59	52.78	52.96	53.15	53.33	53.52
677	623	569	515	461	407	353	299	245	191	137	83	29	53.70	53.89	54.07	54.26	54.44	54.63	54.81	55.00	55.19	55.37

2,000 square foot end areas=3,703.70 cubic yards.
3,000 square foot end areas=5,555.56 cubic yards.
4,000 square foot end areas=7,407.41 cubic yards.
5,000 square foot end areas=9,259.26 cubic yards.

EXAMPLE.—To find cubic yards in 100-foot station (423.6 sum of end areas):

Heading of column in which 423 is found	700
To right of 423 and in column headed 0.6; reading is	84.44
Total	784.44

Table XVIII.—VOLUMES—Continued

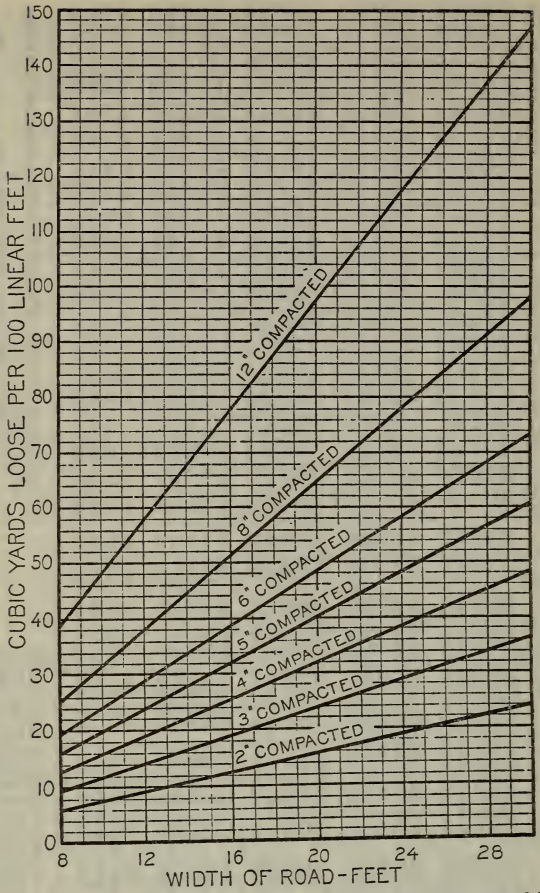
[Cubic yards for sum of end areas 100 feet apart]

1,200	1,100	1,000	900	800	700	600	500	400	300	200	100	00	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
678	624	570	516	462	408	354	300	246	192	138	84	30	55.56	55.74	55.93	56.11	56.30	56.48	56.67	56.85	57.04	57.22
679	625	571	517	463	409	355	301	247	193	139	85	31	57.41	57.59	57.78	57.96	58.15	58.33	58.52	58.70	58.89	59.07
680	626	572	518	464	410	356	302	248	194	140	86	32	59.26	59.44	59.63	59.81	60.00	60.19	60.37	60.56	60.74	60.93
681	627	573	519	465	411	357	303	249	195	141	87	33	61.11	61.30	61.48	61.67	61.85	62.04	62.22	62.41	62.59	62.78
682	628	574	520	466	412	358	304	250	196	142	88	34	62.96	63.15	63.33	63.52	63.70	63.89	64.07	64.26	64.44	64.63
683	629	575	521	467	413	359	305	251	197	143	89	35	64.81	65.00	65.19	65.37	65.56	65.74	65.93	66.11	66.30	66.48
684	630	576	522	468	414	360	306	252	198	144	90	36	66.67	66.85	67.04	67.22	67.41	67.59	67.78	67.96	68.15	68.33
685	631	577	523	469	415	361	307	253	199	145	91	37	68.52	68.70	68.89	69.07	69.26	69.44	69.63	69.81	70.00	70.19
686	632	578	524	470	416	362	308	254	200	146	92	38	70.37	70.56	70.74	70.93	71.11	71.30	71.48	71.67	71.85	72.04
687	633	579	525	471	417	363	309	255	201	147	93	39	72.22	72.41	72.59	72.78	72.96	73.15	73.33	73.52	73.70	73.89
688	634	580	526	472	418	364	310	256	202	148	94	40	74.07	74.26	74.44	74.63	74.81	75.00	75.19	75.37	75.56	75.74
689	635	581	527	473	419	365	311	257	203	149	95	41	75.93	76.11	76.30	76.48	76.67	76.85	77.04	77.22	77.41	77.59
690	636	582	528	474	420	366	312	258	204	150	96	42	77.78	77.96	78.15	78.33	78.52	78.70	78.89	79.07	79.26	79.44
691	637	583	529	475	421	367	313	259	205	151	97	43	79.63	79.81	80.00	80.19	80.37	80.56	80.74	80.93	81.11	81.30
692	638	584	530	476	422	368	314	260	206	152	98	44	81.48	81.67	81.85	82.04	82.22	82.41	82.59	82.78	82.96	83.15
693	639	585	531	477	423	369	315	261	207	153	99	45	83.33	83.52	83.70	83.89	84.07	84.26	84.44	84.63	84.81	85.00
694	640	586	532	478	424	370	316	262	208	154	100	46	85.19	85.37	85.56	85.74	85.93	86.11	86.30	86.48	86.67	86.85
695	641	587	533	479	425	371	317	263	209	155	101	47	87.04	87.22	87.41	87.59	87.78	87.96	88.15	88.33	88.52	88.70
696	642	588	534	480	426	372	318	264	210	156	102	48	88.89	89.07	89.26	89.44	89.63	89.81	90.00	90.19	90.37	90.56
697	643	589	535	481	427	373	319	265	211	157	103	49	90.74	90.93	91.11	91.30	91.48	91.67	91.85	92.04	92.22	92.41
698	644	590	536	482	428	374	320	266	212	158	104	50	92.59	92.78	92.96	93.15	93.33	93.52	93.70	93.89	94.07	94.26
699	645	591	537	483	429	375	321	267	213	159	105	51	94.44	94.63	94.81	95.00	95.19	95.37	95.56	95.74	95.93	96.11
700	646	592	538	484	430	376	322	268	214	160	106	52	96.30	96.48	96.67	96.85	97.04	97.22	97.41	97.59	97.78	97.96
701	647	593	539	485	431	377	323	269	215	161	107	53	98.15	98.33	98.52	98.70	98.89	99.07	99.26	99.44	99.63	99.81

2,000 square foot end areas=3,703.70 cubic yards.
3,000 square foot end areas=5,555.56 cubic yards.
4,000 square foot end areas=7,407.41 cubic yards.
5,000 square foot end areas=9,259.26 cubic yards.

EXAMPLE.—To find cubic yards in 100-foot station (423.6 sum of end areas):

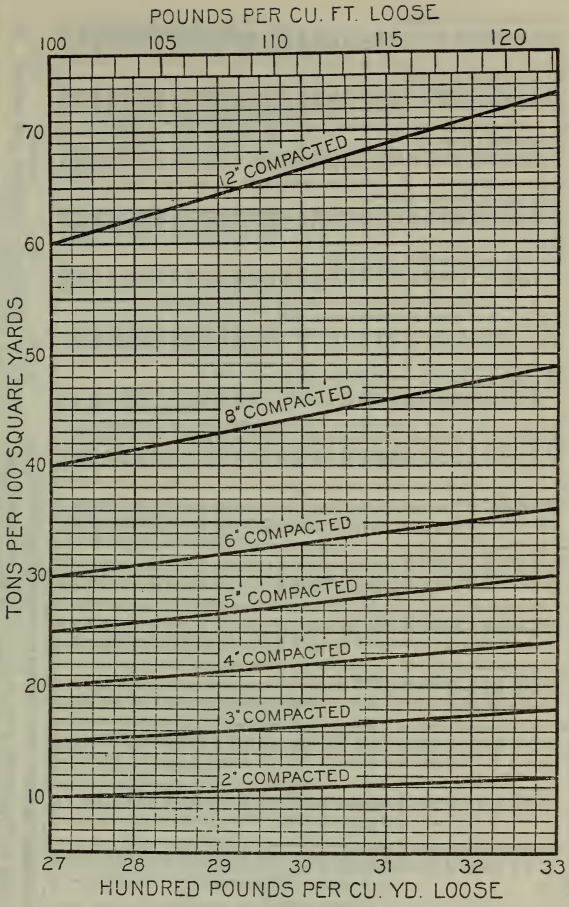
Heading of column in which 423 is found	700
To right of 423 and in column headed 0.6; reading is	84.44
Total	784.44



CUBIC YARDS OF GRAVEL REQUIRED FOR GRAVEL ROAD CONSTRUCTION

FIG. 16

The ratio of compact to loose gravel and crushed stone is approximately 1:1½ or 1:1¼.
To use this diagram in connection with the standard designs, compute the average depth of surfacing in the cross-section.



TONS OF GRAVEL REQUIRED FOR GRAVEL ROAD CONSTRUCTION

FIG. 17

The ratio of compact to loose gravel and crushed stone is approximately 1:1½ or 1:1¼

To use this diagram in connection with the standard designs, compute the average depth of surfacing in the cross-section.

Table XIX.—CARRYING CAPACITY OF SHORT CORRUGATED PIPES

[Capacities are for corrugated culverts with straight end wall entrance, length, 30.6 feet; discharge in cubic feet per second]

[Use for ordinary road culverts and canal turn-outs]

Percent of culvert incline	Head on pipe, in feet	12-inch	15-inch [1]	18-inch	21-inch [1]	24-inch	30-inch	36-inch [1]	42-inch [1]	48-inch [1]	54-inch [1]	60-inch [1]	66-inch [1]	72-inch [1]	78-inch [1]	84-inch [1]
0.033	0.01	0.31	.52	0.79	1.13	1.54	2.57	3.92	5.60	7.62	10.0	12.8	15.9	19.4	23.4	27.7
.066	.02	.44	.73	1.12	1.60	2.17	3.64	5.55	7.92	10.8	14.2	18.0	22.5	27.5	33.1	39.3
.100	.03	.54	.90	1.37	1.96	2.66	4.46	6.79	9.70	13.2	17.3	22.1	27.6	33.7	40.5	48.1
.133	.04	.62	1.04	1.58	2.26	3.07	5.15	7.84	11.2	15.2	20.0	25.5	31.8	38.9	46.8	55.5
.166	.05	.69	1.16	1.77	2.52	3.44	5.76	8.77	12.5	17.0	22.3	28.5	35.6	43.5	52.3	62.1
.200	.06	.76	1.27	1.94	2.77	3.76	6.30	9.61	13.7	18.7	24.5	31.3	39.0	47.7	57.3	68.0
.233	.07	.82	1.37	2.09	2.99	4.07	6.82	10.4	14.8	20.2	26.5	33.8	42.1	51.5	62.0	73.6
.266	.08	.88	1.47	2.24	3.19	4.35	7.28	11.1	15.8	21.5	28.3	36.9	45.0	55.0	66.2	78.5
.300	.09	.93	1.56	2.38	3.39	4.61	7.72	11.8	16.8	22.9	30.0	38.3	47.7	58.4	70.2	83.3
.333	.1	.98	1.64	2.50	3.57	4.86	8.14	12.4	17.7	24.1	31.7	40.4	50.3	61.5	74.0	87.8
.666	.2	1.39	2.32	3.54	5.05	6.87	11.5	17.5	25.0	34.1	44.7	57.1	71.2	87.0	104	124
1.00	.3	1.70	2.84	4.33	6.18	8.42	14.1	21.5	30.7	41.8	54.8	69.9	87.1	106	128	152
1.33	.4	1.96	3.28	5.00	7.14	9.72	16.3	24.8	35.4	48.2	63.3	80.7	106	123	148	175
1.66	.5	2.19	3.67	5.59	7.98	10.9	18.2	27.7	39.6	53.9	70.7	90.3	112	137	165	196
2.00	.6	2.40	4.02	6.13	8.75	11.9	19.9	30.4	43.4	59.1	77.5	98.9	123	158	181	215
2.33	.7	2.59	4.34	6.62	9.45	12.9	21.5	32.8	46.9	63.8	83.7	106	133	163	196	232
2.66	.8	2.77	4.64	7.07	10.1	13.8	23.0	35.1	50.1	68.2	89.4	114	142	172	209	248
3.00	.9	2.94	4.92	7.51	10.7	14.6	24.4	37.2	53.1	72.3	94.9	121	151	184	212	263
3.33	1.0	3.10	5.19	7.91	11.3	15.4	25.7	39.2	56.0	76.2	100	127	159	194	234	277
3.66	1.2	3.40	5.69	8.66	12.4	16.8	28.2	43.0	61.3	83.5	109	140	174	213	256	304
4.66	1.4	3.67	6.14	9.36	13.4	18.2	30.5	46.4	66.3	90.2	118	151	188	230	277	328
5.33	1.6	3.92	6.57	10.00	14.3	19.4	32.6	49.6	70.8	96.4	126	161	201	246	296	351
6.00	1.8	4.16	6.96	10.60	15.2	20.6	34.5	52.6	75.1	102.0	134	171	213	261	314	372
6.66	2.0	4.38	7.34	11.20	16.0	21.7	36.4	55.5	79.2	108	142	180	225	275	331	392
7.33	2.2	4.60	7.70	11.74	16.8	22.8	38.2	58.2	83.1	113	148	189	236	289	347	413
8.00	2.4	4.80	8.04	12.25	17.5	23.8	39.9	60.8	86.8	118	155	198	246	301	362	430
8.66	2.6	5.00	8.37	12.81	18.2	24.8	41.7	63.0	90.3	123	161	206	257	314	377	448
9.33	2.8	5.19	8.69	13.24	18.9	25.7	43.1	65.6	93.7	128	167	213	266	325	392	465
10.00	3.0	5.37	8.99	13.70	19.6	26.6	44.6	67.9	97.0	132	173	221	276	337	405	481
10.66	3.2	5.55	9.29	14.26	20.2	27.5	46.1	70.2	100.2	136	179	228	285	348	418	497
11.33	3.4	5.72	9.57	14.60	20.8	28.4	47.5	72.3	103.5	141	184	235	293	359	431	512
11.66	3.5	5.80	9.71	14.80	21.1	28.8	48.2	73.4	105.0	143	187	239	298	364	438	519

[1] No experiments made on these sizes; quantity computed by formula.

This table is based on the formula $Q=3.10\ D^{2.31}\ H^{0.50}$ for corrugated pipe, in which Q=discharge in cubic feet per second. D=diameter of pipe in feet and H=head on pipe, in feet — difference of elevation of inlet and outlet ends of pipe.

Compiled from figures obtained through a series of tests made by the Bureau of Public Roads at the hydraulic testing plant of the University of Iowa. This table can be used for shorter lengths of pipe with little error. For shorter pipe the capacities would be somewhat greater for equal heads, the capacity of a 14-foot pipe being nearly 20 percent greater than for a 30-foot length of the same diameter.

Table XX.—APPROXIMATE CAPACITY OF FLOW OF DIFFERENT SIZED CONCRETE PIPES IN CUBIC FEET PER SECOND

Grade, percent	12-inch	15-inch	18-inch	24-inch	36-inch	48-inch
0.5	2.4	4.4	7.5	16	42	102
1	3.3	6.3	10.5	23	60	143
1.5	4.2	7.6	13.0	27	75	175
2	4.8	8.8	15.0	31	86	204
3	5.8	11.0	18.0	39	105	248
4	6.5	13.0	22.0	46	122	285
5	7.3	14.0	24.0	51	137	320
6	8.1	15.0	26.0	56	150	350
7	8.8	16.0	27.0	60	162	375
8	9.5	17.0	28.0	65	173	405
Weight per foot (pounds)	90	120	170	260	500	870

Table XXI.—RELATIVE CARRYING CAPACITIES OF CORRUGATED CULVERTS UNDER AVERAGE CONDITIONS

Example.—How many 12-inch culverts will carry the same amount of water as a 36-inch culvert? In vertical column for 12-inch, find, opposite 36-inch in horizontal column, 12.65. Ans.

Diameter	Diameter														
	12-inch	15-inch	18-inch	21-inch	24-inch	30-inch	36-inch	42-inch	48-inch	54-inch	60-inch	66-inch	72-inch	78-inch	84-inch
12-inch	1.00														
15-inch	1.67	1.00													
18-inch	2.54	1.58	1.00												
21-inch	3.63	2.28	1.43	1.00											
24-inch	4.95	3.07	1.94	1.36	1.00										
30-inch	8.29	4.96	3.25	2.28	1.68	1.00									
36-inch	12.65	7.57	4.97	3.48	2.56	1.52	1.00								
42-inch	18.06	10.62	7.07	4.98	3.65	2.18	1.43	1.00							
48-inch	24.60	14.74	9.65	6.78	4.97	2.97	1.94	1.36	1.00						
54-inch	32.21	19.30	12.66	8.87	6.52	3.88	2.55	1.78	1.31	1.00					
60-inch	41.20	24.60	16.15	11.33	8.31	4.95	3.24	2.28	1.62	1.26	1.00				
66-inch	51.25	30.63	20.12	14.10	10.36	6.18	4.05	2.84	2.08	1.59	1.25	1.00			
72-inch	67.40	37.35	24.45	17.18	12.60	7.51	4.93	3.45	2.53	1.94	1.52	1.22	1.00		
78-inch	75.25	45.10	29.50	20.72	15.22	9.07	5.95	4.17	3.06	2.34	1.83	1.47	1.21	1.00	
84-inch	89.45	53.50	35.50	24.65	18.08	10.78	7.07	4.95	3.64	2.78	2.17	1.74	1.43	1.19	1.00

Table XXII.—RECOMMENDED GAGE AND WEIGHT OF CORRUGATED-METAL CULVERTS

Size	Area, in square feet	Gage	Weight per foot (pounds)	Bands		
				Width, inches	Gage	Weight (pounds)
12-inch	0.785	16	10.8	7	16	9.5
15-inch	1.227	16	13.1	7	16	10.8
18-inch	1.767	16	15.7	12	16	20.4
21-inch	2.405	16	18.4	12	16	22.8
24-inch	3.142	14	25.4	12	16	25.4
30-inch	4.909	14	31.9	12	14	36.0
36-inch	7.069	12	52.0	12	14	41.8
42-inch	9.621	12	60.6	12	14	48.0
48-inch	12.566	12	70.6	12	14	55.3
54-inch	15.904	12	79.0	24	14	124.2
60-inch	19.635	10	109.1	24	12	182.8
66-inch	23.758	10	119.7	24	12	199.3
72-inch	28.274	10	130.2	24	12	215.8
78-inch	33.183	8	176.5	24	12	233.2
84-inch	38.485	8	189.6	24	12	250.6

Table XXIII.—INGREDIENTS REQUIRED FOR 1 CUBIC YARD OF RAMMED CONCRETE

Proportion of ingredients			Stone 1 inch and under, dust screened out			Stone 2½ inches and under, dust screened out			Stone, 2½ inches, with most small stone screened out			Gravel, ¾ inch and under		
Cement	Sand	Stone	Cement	Sand	Stone	Cement	Sand	Stone	Cement	Sand	Stone	Cement	Sand	Stone
			Bbl.	*Cu. yd.*	*Cu. yd.*	*Bbl.*	*Cu. yd.*	*Cu. yd.*	*Bbl.*	*Cu. yd.*	*Cu. yd.*	*Bbl.*	*Cu. yd.*	*Cu. yd.*
1	1.0	2.0	2.57	0.39	0.78	2.63	0.40	0.80	2.72	0.41	0.83	2.30	0.35	0.74
1	1.0	2.5	2.29	.35	.88	2.34	.36	.89	2.41	.37	.92	2.10	.32	.80
1	1.0	3.0	2.06	.31	.94	2.10	.32	.96	2.16	.33	.98	1.89	.29	.86
1	1.0	3.5	1.84	.28	.98	1.88	.29	1.00	1.88	.29	1.05	1.71	.26	.91
1	1.5	2.5	2.05	.47	.78	2.09	.48	.80	2.16	.49	.82	1.83	.42	.73
1	1.5	3.0	1.85	.42	.84	1.90	.43	.87	1.96	.45	.89	1.71	.39	.78
1	1.5	3.5	1.72	.39	.91	1.74	.40	.93	1.79	.41	.96	1.57	.36	.83
1	1.5	4.0	1.57	.36	.96	1.61	.37	.98	1.64	.38	1.00	1.46	.33	.88
1	1.5	4.5	1.43	.33	.98	1.46	.33	1.00	1.51	.35	1.06	1.34	.31	.91
1	1.75	2.75	1.87	.49	.77	1.91	.51	.80	1.98	.52	.82	1.67	.44	.69
1	2.0	3.0	1.70	.52	.77	1.73	.53	.79	1.78	.54	.81	1.54	.47	.73
1	2.0	3.25	1.65	.50	.81	1.68	.50	.81	1.74	.52	.84	1.47	.44	.72
1	2.0	3.5	1.57	.48	.83	1.61	.49	.85	1.66	.50	.88	1.44	.44	.77
1	2.0	3.75	1.52	.46	.86	1.56	.48	.88	1.61	.48	.90	1.36	.42	.79
1	2.0	4.0	1.46	.44	.89	1.48	.45	.90	1.53	.47	.93	1.34	.41	.81
1	2.0	4.5	1.36	.42	.93	1.38	.42	.95	1.43	.43	.98	1.26	.38	.86
1	2.0	5.0	1.27	.39	.97	1.29	.39	.98	1.33	.39	1.03	1.17	.36	.89
1	2.25	3.5	1.52	.52	.80	1.56	.54	.84	1.61	.54	.84	1.36	.47	.74
1	2.25	4.0	1.42	.49	.83	1.45	.49	.88	1.50	.52	.92	1.28	.43	.76
1	2.5	3.5	1.45	.55	.77	1.48	.56	.79	1.51	.58	.81	1.32	.50	.70
1	2.5	4.0	1.35	.52	.82	1.38	.53	.84	1.42	.54	.87	1.24	.47	.75
1	2.5	4.5	1.27	.48	.87	1.29	.49	.88	1.33	.51	.91	1.16	.44	.80
1	2.5	5.0	1.19	.46	.91	1.21	.46	.92	1.26	.48	.96	1.10	.42	.83
1	2.5	5.5	1.13	.43	.94	1.15	.44	.96	1.18	.44	.99	1.03	.39	.86
1	2.5	6.0	1.07	.41	.97	1.07	.41	.98	1.10	.41	1.03	.98	.37	.89
1	2.75	4.5	1.25	.52	.85	1.28	.52	.76	1.32	.55	.90	1.12	.47	.76
1	3.0	4.0	1.26	.58	.77	1.28	.58	.78	1.32	.60	.80	1.15	.52	.72
1	3.0	4.5	1.18	.54	.81	1.20	.55	.82	1.24	.57	.85	1.09	.50	.75
1	3.0	5.0	1.11	.51	.85	1.14	.52	.87	1.17	.54	.89	1.03	.47	.78
1	3.0	5.5	1.06	.48	.89	1.07	.49	.90	1.11	.51	.93	.97	.44	.81
1	3.0	6.0	1.01	.46	.92	1.02	.47	.93	1.06	.48	.97	.92	.42	.84

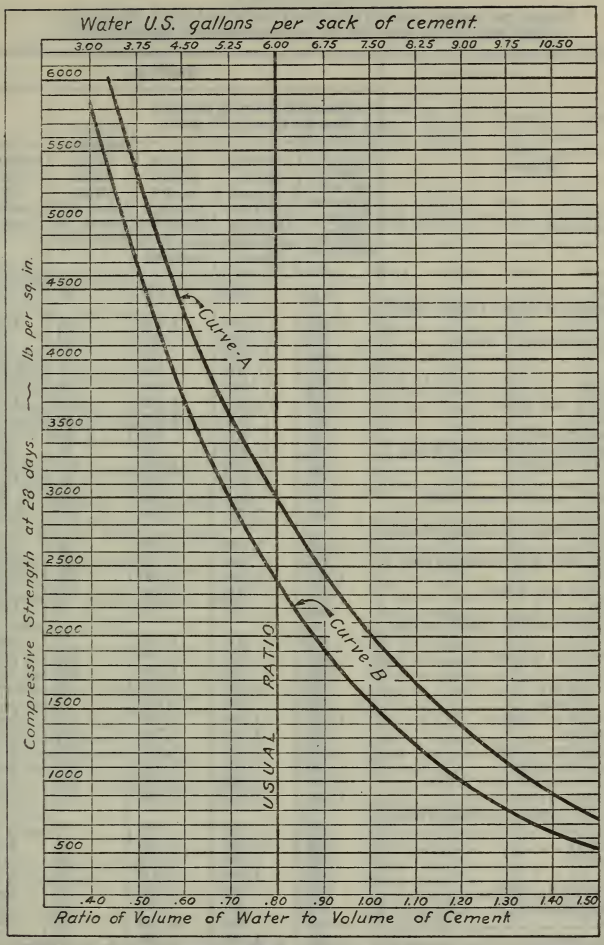


FIG. 18

Effect of quantity of mixing water on the strength of concrete. Curves based on average values from nine series of tests made over a period of 4 years. Curve A to be used for design where the water-cement ratio is carefully controlled by accurate measurement of quantities of water, cement, and aggregate, with proper correction for water carried by the aggregate. Curve B to be used for design where the water-cement ratio is indifferently controlled and where only rough methods are used for measuring quantities of materials.

Cr. Portland Cement Ass'n.

Table XXIV.—WORKING STRESSES PERMISSIBLE—BENDING

Pounds per square inch for structural timbers of select (S2) grade [1]
[Department Circular 295, U. S. Department of Agriculture]

Species	Bending				
	Allowable stress in extreme fiber for select (S2) grade			Allowable horizontal shear stress, select (S2) grade, all locations [2]	Allowable modulus of lasticity for all grades, all locations
	Damp or wet location (docks, piling, and sills)	Outside, not in contact with soil (bridges and open sheds)	Under shelter in dry location (factories and warehouses)		
Ash, black	800	900	1,000	90	1,100,000
Ash, commercial white (green, biltmore, white)	1,000	1,200	1,400	125	1,500,000
Aspen and large-tooth aspen	500	650	800	80	900,000
Basswood	500	650	800	80	900,000
Beech	1,000	1,300	1,500	125	1,600,000
Birch, paper	600	750	900	80	1,000,000
Birch, yellow and sweet	1,000	1,300	1,500	120	1,600,000
Cedar, Alaska	800	900	1,000	90	1,100,000
Cedar, western red	750	800	900	80	1,000,000
Cedar, northern and southern white	600	650	750	70	800,000
Cedar, Port Orford	900	1,000	1,100	100	1,200,000
Chestnut	700	850	950	90	1,000,000
Cottonwood, common and black	500	650	800	80	900,000
Cypress, bald	900	1,100	1,300	100	1,400,000
Douglas fir (western Washington and Oregon) [3]	1,000	1,300	1,500	90	1,600,000
Douglas fir (Rocky Mountain type)	700	900	1,100	85	1,200,000
Elm, cork	1,000	1,300	1,500	125	1,300,000
Elm, slippery and white	800	900	1,100	100	1,200,000
Fir, balsam	600	750	900	70	1,000,000
Fir, commercial white (white, noble, grand)	800	900	1,100	70	1,200,000
Gum, black and cotton	800	900	1,100	100	1,200,000
Gum, red	800	900	1,100	100	1,200,000
Hemlock, western	900	1,100	1,300	75	1,400,000
Hemlock, eastern	800	900	1,000	70	1,100,000
Hickory, true and pecan	1,200	1,500	1,900	140	1,800,000
Larch, western	900	1,100	1,200	100	1,300,000
Maple, sugar and black	1,000	1,300	1,500	150	1,600,000
Maple, red and silver	700	900	1,000	100	1,100,000
Oak, commercial red and white	1,000	1,200	1,400	125	1,500,000
Pine, southern yellow [3]	1,000	1,300	1,500	110	1,600,000
Pine, white, sugar, western white, western yellow	750	800	900	85	1,000,000
Pine, Norway	800	1,000	1,100	85	1,200,000
Poplar, yellow	800	900	1,000	80	1,100,000
Redwood	800	1,000	1,200	70	1,200,000
Spruce, red white, Sitka	800	900	1,100	85	1,200,000
Spruce, Engelmann	500	650	750	70	800,000
Sycamore	800	900	1,100	80	1,200,000
Tamarack, eastern	900	1,100	1,200	95	1,300,000

[1] Working stresses for extra select (S1), extra select (S1) dense, standard (S3), and common (S4) grades are obtained by multiplying the basic stress by 7/6, 8/6, 5/6, and 4/6, respectively.

[2] Maximum safe load due to horizontal shear=4/3 area sec. x unit shearing stress.

[3] The working stresses of any grade of timbers of Douglas fir and southern yellow pine which meet the density requirements of the American Society for Testing Materials shall be increased 1/6 the allowable stress given in the table for the basic or select (S2) grade.

Table XXV.—WORKING STRESSES PERMISSIBLE—COMPRESSION

Pounds per square inch for structural timbers of select (S2) grade

Species	Compression					
	Allowable stress parallel to grain "short columns" for select (S2) grade [1]			Allowable stress perpendicular to grain for all grades		
	Wet location	Dry outside location	Dry inside location	Wet location	Dry outside location	Dry inside location
Ash, black	500	550	650	150	200	300
Ash, commercial white (green, biltmore, white)	900	1,000	1,100	300	375	500
Aspen and large-tooth aspen	450	550	700	100	125	150
Basswood	450	550	700	100	125	150
Beech	900	1,100	1,200	300	375	500
Birch, paper	450	550	650	100	150	200
Birch, yellow and sweet	900	1,100	1,200	300	375	500
Cedar, Alaska	650	750	800	150	200	250
Cedar, western red	650	700	700	125	150	200
Cedar, northern and southern white	450	500	550	100	140	175
Cedar, Port Orford	750	825	900	150	200	250
Chestnut	600	700	800	150	200	300
Cottonwood, common and black	450	550	700	100	125	150
Cypress, bald	800	1,000	1,100	225	250	350
Douglas fir (western Washington and Oregon) [2]	850	1,000	1,100	200	225	325
Douglas fir (Rocky Mountain type)	700	800	800	200	225	275
Elm, cork	900	1,100	1,200	300	375	500
Elm, slippery and white	650	750	800	125	175	250
Fir, balsam	500	600	700	100	125	150
Fir, commercial white (white, noble, grand)	650	750	800	150	200	300
Gum, black and cotton	650	750	800	150	200	300
Gum, red	650	750	800	150	200	300
Hemlock, western	800	900	900	200	225	300
Hemlock, eastern	600	700	700	200	225	300
Hickory, true and pecan	1,000	1,200	1,500	350	400	600
Larch, western	800	1,000	1,100	200	275	325
Maple, sugar and black	900	1,100	1,200	300	375	500
Maple, red and silver	600	700	800	200	250	350
Oak, commercial red and white	800	900	1,000	300	375	500
Pine, southern yellow [2]	850	1,000	1,100	200	225	325
Pine, white, sugar, western white, western yellow	650	750	750	125	150	250
Pine, Norway	700	800	800	150	175	300
Poplar, yellow	600	700	800	125	150	250
Redwood	750	900	1,000	125	150	250
Spruce, red, white, Sitka	650	750	800	125	150	250
Spruce, Engelmann	450	550	600	100	140	175
Sycamore	650	750	800	150	200	300
Tamarack, eastern	800	900	1,000	200	225	300

[1] The influence of knots on compressive strength of columns of constant cross section decreases as the length increases. When the length reaches 30 times the least dimension, knots such as are allowable in select (S2) timbers have no appreciable effect on the strength as a column.

[2] The working stresses of any grade of timbers of Douglas fir and southern yellow pine which meet the density requirements of the American Society for Testing Materials shall be increased 1/6 the allowable stress given in the table for the basic or select (S2) grade.

SIMPLE BEAM FORMULAE

$M_{max.}$ = Maximum moment in inch-pounds.
L = Length of beam in inches.
I = Moment of inertia = $\frac{bd^3}{12}$
c = ½ depth of beam in inches.
b = Breadth of beam in inches.
d = Depth of beam in inches.
s = Allowable tensile stress per square inch.
W = Total load on beam, pounds.

$M_{max.} = \frac{1}{4} PL$ (concentrated load).
$M_{max.} = \frac{1}{8} WL$ (uniform load).

Maximum safe uniform load = $\frac{8sI}{Lc}$

Maximum safe concentrated load = $\frac{4sI}{Lc}$

Table XXVI.—RELATIVE STRENGTHS OF SQUARE AND ROUND TIMBER BEAMS

Sawed lumber (b x d)	Square lumber, corresponding	Round timber, corresponding diameter	Sawed lumber (b x d)	Square lumber, corresponding	Round timber, corresponding diameter
	Inches	*Inches*		*Inches*	*Inches*
3 x 8 inches	6	7	7 x 7 inches	7	8
3 x 10 inches	7	8	7 x 10 inches	9	10
3 x 12 inches	8	9	7 x 12 inches	10	11
4 x 6 inches	6	7	8 x 8 inches	8	9
4 x 8 inches	7	8	8 x 10 inches	9	10
4 x 10 inches	8	9	8 x 12 inches	11	13
4 x 12 inches	9	10	10 x 10 inches	10	11
6 x 6 inches	6	7	10 x 12 inches	12	14
6 x 8 inches	7	8	12 x 12 inches	12	14
6 x 10 inches	9	10	12 x 14 inches	13	15
6 x 12 inches	10	11	14 x 14 inches	14	16

Table XXVII.—SIZE OF STRINGERS FOR VARIOUS ALLOWABLE STRESSES—9 STRINGERS REQUIRED

Stress	Spans for H-10 loading							
	9 feet	11 feet	13 feet	15 feet	17 feet	21 feet	25 feet	29 feet
900	4 x 12	5 x 12	6 x 12	6 x 12	6 x 14	8 x 14	10 x 14	10 x 16
1,000	4 x 12	5 x 12	5 x 12	4 x 14	6 x 14	6 x 14	10 x 14	8 x 16
1,100	3 x 12	4 x 12	5 x 12	5 x 12	6 x 14	6 x 14	8 x 14	8 x 16
1,200	3 x 12	4 x 12	4 x 12	5 x 12	6 x 12	6 x 14	8 x 14	8 x 16
1,300	3 x 12	4 x 12	4 x 12	5 x 14	4 x 14	6 x 14	8 x 14	6 x 16
1,400	3 x 12	4 x 12	4 x 12	4 x 12	5 x 12	6 x 12	6 x 14	8 x 14
1,500	3 x 12	3 x 12	4 x 12	4 x 12	4 x 12	4 x 14	6 x 14	8 x 14
	Spans for H-15 loading							
900	4 x 14	6 x 14	6 x 14	8 x 14	8 x 14	8 x 16	10 x 16	10 x 18
1,000	5 x 12	6 x 12	6 x 14	8 x 14	8 x 14	8 x 16	10 x 16	10 x 18
1,100	5 x 12	4 x 14	6 x 14	6 x 14	8 x 14	8 x 16	8 x 16	10 x 16
1,200	4 x 12	5 x 12	6 x 12	6 x 14	6 x 14	8 x 14	8 x 16	10 x 16
1,300	4 x 12	5 x 12	4 x 14	6 x 14	6 x 14	8 x 14	8 x 16	8 x 16
1,400	4 x 12	5 x 12	5 x 12	6 x 12	6 x 14	8 x 14	8 x 14	8 x 16
1,500	4 x 12	4 x 12	5 x 12	6 x 12	6 x 14	8 x 14	8 x 14	8 x 16

Table XXVIII.—CONTENTS OF LUMBER

[Number of board feet in various sizes, for lengths given]

Size of piece	Length of piece, in feet							
	10	12	14	16	18	20	22	24
2 x 4 inches	6⅔	8	9⅓	10⅔	12	13⅓	14⅔	16
2 x 6 inches	10	12	14	16	18	20	22	24
2 x 8 inches	13⅓	16	18⅔	21⅓	24	26⅔	29⅓	32
2 x 10 inches	16⅔	20	23⅓	26⅔	30	33⅓	36⅔	40
2 x 12 inches	20	24	28	32	36	40	44	48
2 x 14 inches	23⅓	28	32⅔	37⅓	42	46⅔	51⅓	56
2 x 16 inches	26⅔	32	37⅓	42⅔	48	53⅓	58⅔	64
3 x 6 inches	15	18	21	24	27	30	33	36
3 x 8 inches	20	24	28	32	36	40	44	48
3 x 10 inches	25	30	35	40	45	50	55	60
3 x 12 inches	30	36	42	48	54	60	66	72
3 x 14 inches	35	42	49	56	63	70	77	84
3 x 16 inches	40	48	56	64	72	80	88	96
4 x 4 inches	13⅓	16	18⅔	21⅓	24	26⅔	29⅓	32
4 x 6 inches	20	24	28	32	36	40	44	48
4 x 8 inches	26⅔	32	37⅓	42⅔	48	53⅓	58⅔	64
4 x 10 inches	33⅓	40	46⅔	53⅓	60	66⅔	73⅓	80
4 x 12 inches	40	48	56	64	72	80	88	96
4 x 14 inches	46⅔	56	65⅓	74⅔	84	93⅓	102⅔	112
4 x 16 inches	53⅓	64	74⅔	85⅓	96	106⅔	117⅓	128
6 x 6 inches	30	36	42	48	54	60	66	72
6 x 8 inches	40	48	56	64	72	80	88	96
6 x 10 inches	50	60	70	80	90	100	110	120
6 x 12 inches	60	72	84	96	108	120	132	144
6 x 14 inches	70	84	98	112	126	140	154	168
6 x 16 inches	80	96	112	128	144	160	176	192
6 x 18 inches	90	108	126	144	162	188	198	216
6 x 20 inches	100	120	140	160	180	200	220	240
8 x 8 inches	53⅓	64	74⅔	85⅓	96	106⅔	117⅓	128
8 x 10 inches	66⅔	80	93⅓	106⅔	120	133⅓	146⅔	160
8 x 12 inches	80	96	112	128	144	160	176	192
8 x 14 inches	93⅓	112	130⅔	149⅓	168	186⅔	205⅓	224
10 x 10 inches	83⅓	100	116⅔	133⅓	150	166⅔	183⅓	200
10 x 12 inches	100	120	140	160	180	200	220	240
10 x 14 inches	116⅔	140	163⅓	186⅔	210	233⅓	256⅔	280
10 x 16 inches	133⅓	160	186⅔	213⅓	240	266⅔	293⅓	320
12 x 12 inches	120	144	168	192	216	240	264	288
12 x 14 inches	140	168	196	224	252	280	308	336
12 x 16 inches	160	192	224	256	288	320	352	384
14 x 14 inches	163⅓	196	228⅔	261⅓	294	326⅔	359⅓	392
14 x 16 inches	186⅔	224	261⅓	298⅔	336	373⅓	410⅔	448

Table XXIX.—INCHES REDUCED TO DECIMALS OF A FOOT

Inches	Foot	Inches	Foot	Inches	Foot	Inches	Foot	Inches	Foot	Inches	Foot
0	0.0000	2	0.1667	4	0.3333	6	0.5000	8	0.6667	10	0.8333
1/32	.0026		.1693		.3359		.5026		.6693		.8359
1/16	.0052		.1719		.3385		.5052		.6719		.8385
3/32	.0078		.1745		.3411		.5078		.6745		.8411
1/8	.0104	1/8	.1771	1/8	.3438	1/8	.5104	1/8	.6771	1/8	.8438
5/32	.0130		.1797		.3464		.5130		.6797		.8464
3/16	.0156		.1823		.3490		.5156		.6823		.8490
7/32	.0182		.1849		.3516		.5182		.6849		.8516
1/4	.0208	1/4	.1875	1/4	.3542	1/4	.5208	1/4	.6875	1/4	.8542
9/32	.0234		.1901		.3568		.5234		.6901		.8568
5/16	.0260		.1927		.3594		.5260		.6927		.8594
11/32	.0286		.1953		.3620		.5286		.6953		.8620
3/8	.0313	3/8	.1979	3/8	.3646	3/8	.5313	3/8	.6979	3/8	.8646
13/32	.0339		.2005		.3672		.5339		.7005		.8672
7/16	.0365		.2031		.3698		.5365		.7031		.8698
15/32	.0391		.2057		.3724		.5391		.7057		.8724
1/2	.0417	1/2	.2083	1/2	.3750	1/2	.5417	1/2	.7083	1/2	.8750
17/32	.0443		.2109		.3776		.5443		.7109		.8776
9/16	.0469		.2135		.3802		.5469		.7135		.8802
19/32	.0495		.2161		.3828		.5495		.7161		.8828
5/8	.0521	5/8	.2188	5/8	.3854	5/8	.5521	5/8	.7188	5/8	.8854
21/32	.0547		.2214		.3880		.5547		.7214		.8880
11/16	.0573		.2240		.3906		.5573		.7240		.8906
23/32	.0599		.2266		.3932		.5599		.7266		.8932
3/4	.0625	3/4	.2292	3/4	.3958	3/4	.5625	3/4	.7292	3/4	.8958
25/32	.0651		.2318		.3984		.5651		.7318		.8984
13/16	.0677		.2344		.4010		.5677		.7344		.9010
27/32	.0703		.2370		.4036		.5703		.7370		.9036
7/8	.0729	7/8	.2396	7/8	.4063	7/8	.5729	7/8	.7396	7/8	.9063
29/32	.0755		.2422		.4089		.5755		.7422		.9089
15/16	.0781		.2448		.4115		.5781		.7448		.9115
31/32	.0807		.2474		.4141		.5807		.7474		.9141
1	.0833	3	.2500	5	.4167	7	.5833	9	.7500	11	.9167
1/32	.0859		.2526		.4193		.5859		.7526		.9193
1/16	.0885		.2552		.4219		.5885		.7552		.9219
3/32	.0911		.2578		.4245		.5911		.7578		.9245
1/8	.0938	1/8	.2604	1/8	.4271	1/8	.5938	1/8	.7604	1/8	.9271
5/32	.0964		.2630		.4297		.5964		.7630		.9297
3/16	.0990		.2656		.4323		.5990		.7656		.9323
7/32	.1016		.2682		.4349		.6016		.7682		.9349
1/4	.1042	1/4	.2708	1/4	.4375	1/4	.6042	1/4	.7708	1/4	.9375
9/32	.1068		.2734		.4401		.6068		.7734		.9401
5/16	.1094		.2760		.4427		.6094		.7760		.9427
11/32	.1120		.2786		.4453		.6120		.7786		.9453
3/8	.1146	3/8	.2813	3/8	.4479	3/8	.6146	3/8	.7813	3/8	.9479
13/32	.1172		.2839		.4505		.6172		.7839		.9505
7/16	.1198		.2865		.4531		.6198		.7865		.9531
15/32	.1224		.2891		.4557		.6224		.7891		.9557
1/2	.1250	1/2	.2917	1/2	.4583	1/2	.6250	1/2	.7917	1/2	.9583
17/32	.1276		.2943		.4609		.6276		.7943		.9609
9/16	.1302		.2969		.4635		.6302		.7969		.9635
19/32	.1328		.2995		.4661		.6328		.7995		.9661
5/8	.1354	5/8	.3021	5/8	.4688	5/8	.6354	5/8	.8021	5/8	.9688
21/32	.1380		.3047		.4714		.6380		.8047		.9714
11/16	.1406		.3073		.4740		.6406		.8073		.9740
23/32	.1432		.3099		.4766		.6432		.8099		.9766
3/4	.1458	3/4	.3125	3/4	.4792	3/4	.6458	3/4	.8125	3/4	.9792
25/32	.1484		.3151		.4818		.6484		.8151		.9818
13/16	.1510		.3177		.4844		.6510		.8177		.9844
27/32	.1536		.3203		.4870		.6536		.8203		.9870
7/8	.1563	7/8	.3229	7/8	.4896	7/8	.6563	7/8	.8229	7/8	.9896
29/32	.1589		.3255		.4922		.6589		.8255		.9922
15/16	.1615		.3281		.4948		.6615		.8281		.9948
31/32	.1641		.3307		.4974		6641		.8307		.9974

Table XXX.—WEIGHTS AND MEASURES

LINEAR UNITS

1 foot=12 inches.
1 yard=36 inches (3 feet).
1 rod=16.5 feet (5.5 yards).
1 mile=5,280 feet (1,760 yards, 320 rods, 80 chains).

Gunthers

1 chain=66 feet (4 rods, 100 links).
1 link=7.92 inches (0.66 foot).

WEIGHT

1 pound=16 ounces.
1 ton, ordinary=2,000 pounds.
1 ton, long=2,240 pounds.

SURFACE

1 square foot=144 square inches.
1 square yard=1,296 square inches (9 square feet).
1 acre=43,560 square feet (4,840 square yards, 160 square rods, 10 square chains).
1 square mile=27,878,400 square feet (3,097,600 square yards, 640 acres).

VOLUME

1 cubic foot=1,728 cubic inches.
1 cubic foot=7.48 United States gallons.
1 cubic yard=46,656 cubic inches (27 cubic feet).
1 acre-foot=325,851 gallons United States liquid (43,560 cubic feet; 1,613,333+cubic yards).

Water

1 cubic foot weighs 62.4283 pounds.
1 cubic yard weighs 1,685.56 pounds.
1 United States gallon weighs 8.34545 pounds.
1 United States gallon=231 cubic inches.
1 Imperial gallon weighs 10.0172 pounds.
1 Imperial gallon=277.27 cubic inches.

Timber

	Weight per f. b. m.			
		Lumber		
	Logs	Green	Dry, rough	Dry, surface
Sugar pine	7.25	4.50	2.50	2.00
California white pine	7.00	3.50	2.50	2.00
White fir (coast)	7.00	4.50	2.70	2.20
Douglas fir	7.00	3.50	3.00	2.50
Western yellow pine	7.00	3.50	2.60	1.90
Western white pine	6.00	3.50	2.40	1.80
Redwood	7.00	3.50	2.40	2.00
Larch	9.00	4.00	2.80	2.50
Spruce	7.00	3.00	2.60	2.30
Western hemlock	8.00	3.50	3.00	2.50
Red cedar	5.50	3.00	2.20	1.70

Materials

	Weight per cubic foot, pounds
Brick (common building)	125
Cement (Portland)	75–90
Concrete 1:2:4 mix (gravel)	152
Concrete 1:3:6 mix (about 5 pounds less).	
Earth:	
Common, loose, and dry	70
Common, moist, and rammed	100
Sand or gravel, loose and dry	100
Sand or gravel, wet	120
Masonry:	
Mortar rubble	155
Dry rubble	125
Crushed gravel	95–104
Crushed granite	90
Crushed limestone	94

Table XXXIV.—WIRE NAILS

Size	Length	Number per pound	Size	Length	Number per pound
	Inches			*Inches*	
2-penny	1	900	20-penny	4	29
3-penny	1¼	615	30-penny	4½	23
4-penny	1½	322	40-penny	5	17
5-penny	1¾	250	50-penny	5½	13½
6-penny	2	200	60-penny	6	10½
7-penny	2¼	154	70-penny	7	7
8-penny	2½	106	80-penny	8	6
9-penny	2¾	85	90-penny	9	5
10-penny	3	74	100-penny	10	4
12-penny	3¼	57	120-penny	12	3
16-penny	3½	46			

FENCE STAPLES

Size	Number per pound	Size	Number per pound	Size	Number per pound
1 inch	108	1¼ inches	87	1¾ inches	65
1⅛ inches	96	1½ inches	72	2 inches	58

NAILS REQUIRED FOR DIFFERENT KINDS OF WORK

For 1,000 shingles, 4 to 5 pounds of fourpenny nails, or 3 to 3½ pounds of threepenny.
For 1,000 laths, about 8 pounds of twopenny fine.
For 1,000 clapboards, about 20 pounds of sixpenny.
For 1,000 feet covering boards, about 20 pounds of eightpenny, or 25 pounds of tenpenny.
For 1,000 feet upper floors, square edge, about 38 pounds of tenpenny, or 41 pounds of twelvepenny.
For 1,000 feet upper floors, matched and blind-nailed, 38 pounds of tenpenny, or 42 pounds of twelvepenny.
For 1,000 feet 1 by 3, about 45 pounds of tenpenny.
For 1,000 feet 1 by 2, about 65 pounds of tenpenny.
For 1,000 feet pine finish, about 30 pounds of eightpenny.

Table XXXII.—STRENGTH OF MATERIALS—STRESSES IN POUNDS PER SQUARE INCH

Building materials	Ultimate average stresses			Modulus of elasticity	Safe working stresses		
	Compression	Tension	Bending		Compression	Bending	Shearing
STONE							
Granite, gneiss, bluestone	12,000	1,200	1,600	7,000,000	1,200	1,200	200
Limestone, marble	8,000	800	1,500	7,000,000	800	800	150
Sandstone	5,000	150	1,200	3,000,000	500	500	150
Slate	10,000	3,000	5,000	14,000,000	1,000	1,000	175
MASONRY							
Granite					420	600	
Limestone, bluestone					350	500	
Sandstone					280	400	
Rubble					140	250	
Rubble, coursed					170	250	
Brick, medium burned	10,000				170	300	
Brick, hard burned	15,000				210	300	
Brick, pressed, paving brick	6,000						
Terra cotta	5,000						
CEMENT, PORTLAND							
Neat, 28 days	7,040	740					
Neat, 90 days	7,350	740					
1:3 sand, 28 days	1,290	320					
1:3 sand, 90 days	1,490	340					
CONCRETE, P. C.							
1:1:2 Granite, trap rock	3,300						
1:1:2 Furnace slag	3,000						
1:1:2 Lime and sandstone, hard	3,000						
1:1:2 Lime and sandstone, soft	2,200						
1:1:2 Cinders	800						
1:1½:3 Granite, trap rock	2,800						
1:1½:3 Furnace slag	2,500						
1:1½:3 Lime and sandstone, hard	2,500						
1:1½:3 Lime and sandstone, soft	1,800						
1:1½:3 Cinders	700						
1:2:4 Granite, trap rock	2,200						
1:2:4 Furnace slag	2,000						
1:2:4 Lime and sandstone, hard	2,000						
1:2:4 Lime and sandstone, soft	1,500						
1:2:4 Cinders	600						
1:2½:5 Granite, trap rock	1,800						
1:2½:5 Furnace slag	1,600						
1:2½:5 Lime and sandstone, hard	1,600						
1:2½:5 Lime and sandstone, soft	1,200						
1:2½:5 Cinders	500						
1:3:6 Granite, trap rock	1,400						
1:3:6 Furnace slag	1,300						
1:3:6 Lime and sandstone, hard	1,300						
1:3:6 Lime and sandstone, soft	1,000						
1:3:6 Cinders	400						

REINFORCED CONCRETE

Modulus of elasticity:
3,000,000 for ultimate compression over 2,900.
2,500,000 for ultimate compression up to 2,900.
2,000,000 for ultimate compression up to 2,200.
750,000 for ultimate compression under 800.

SAFE WORKING STRESSES IN PERCENT OF ULTIMATE COMPRESSION

	Percent
Compression:	
Plain concrete piers, length 4 diameters	22.5
Reinforced columns, length 12 diameters	22.5
Reinforced beams	32.5
Bearing, surface twice the loaded area	35.0
Shear and diagonal tension:	
Horizontal bars, no web reinforcement	2.0
Horizontal bars, vertical stirrups	4.5
Bent bars and vertical stirrups	5.0
Same, securely attached	6.0
Bond stress:	
Drawn wire	2.0
Plain reinforcing bars	4.0
Deformed bars, best type	5.0

Table XXXIII.—SAFE BEARING CAPACITY OF SOILS

[Tons per square foot]

Kind of material	Minimum	Maximum
Rock, hardest, native bed	200	
Rock, equal best ashler masonry	25	30
Rock, equal best brick masonry	15	20
Rock, equal poor brick masonry	5	10
Clay, thick beds, always dry	6	8
Clay, thick beds, moderately dry	4	6
Clay, soft	1	2
Gravel and coarse sand well cemented	8	10
Sand, dry, compact, well cemented	4	6
Sand, clean, dry	2	4
Quicksand, alluvial soils, etc.	.5	1